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THE MISSISSIPPI RIVER FROM CAPE GIRARDEAU TO THE HEAD OF THE PASSES.*

BY

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PURPOSE.—The object of this paper is to review, in part, the Annual Reports of the Mississippi River Commission from 1883 to the present time, and to present certain problems therein discussed and others which arise from the study of the "Preliminary Maps of the Mississippi River from the mouth of the Ohio to the Head of the Passes," published by the Mississippi River Commission (1881–1885, 32 sheets; 1 inch equals 1 mile), and republished in 1894, with the results of the later survey entered in a marked overprint. The old survey in black and the new in red place in strong contrast the positions of the river over a period of thirteen years, and yield effective evidence of the changes in operation.

The publications of the Commission comprise many reports in the form of letters from engineers, detailed to different sections, and these are accompanied by much tabulated data and numerous maps. Some of these reports merely purport that a task assigned has been completed; others contain a great deal of valuable information. The lack of a complete index renders the publications unavailable for easy reference.

DEFINITIONS.—Before a discussion of the river is undertaken a clear understanding in regard to the use of certain terms is necessary. For the purposes of this article the following definitions of terms will be used:

The Mississippi River is conveniently divided into the Upper

* The author acknowledges the aid of Prof. W. M. Davis, under whose supervision this article was written.

Mississippi and the Lower Mississippi. The Lower Mississippi extends from St. Louis to the Gulf. The Upper Mississippi, like the Missouri and the Ohio, is treated as a tributary of the Lower Mississippi.

A meander (Fig. 1) is the well-formed curve of a river developed on a flood-plain. When two or more meanders occur on the same side of a stream a line drawn tangent to two adjacent curves represents the boundary of the meander belt on that side. The meander belt is the area between tangents on opposite sides of the stream. The tongue of land within the meander is the lobe. When the lobe lies between two meanders, and is connected with the mainland by a narrow passage, the narrow passage is the neck. The cutting action of the river narrows the neck until finally the river breaks through and forms a new channel or a cut-off. When a cut-off is established the former path of the river around the meander is deserted and the isolated meander becomes an oxbow lake or a lake. The average of the radii of the curves of any meander is the radius of curvature.

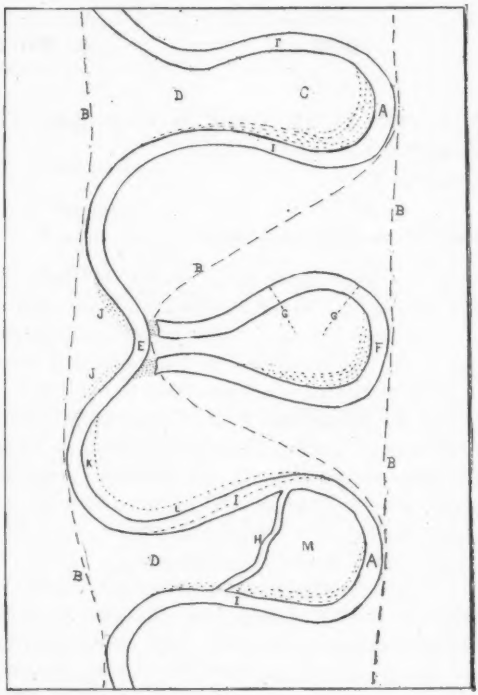


FIG. 1.

A=Meander or Bend. B=Boundary of Meander Belt, showing collapse of same after cut-off. C=Lobe, Spur or Point. D=Neck. E=Cut-off. F=Ox-bow Lake or Lake. G=Radius of Curves. H=Chutes. I=Crossings. J=Fill. K=Toe-cap flood-plain. L=Scroll flood-plain. M=Island.

By the slope of the river the inclination of the water surface may be understood. The sectional area is a cross section, perpendicular

to the current, and is expressed in square feet. The discharge is the volume of water passing towards the sea in a given unit of time. The stage of a river means the height of water surface at a given point above or below a fixed plane of reference. The plane is ordinarily selected at the level of lowest-known water. The stage, therefore, indicates the danger of overflow in adjacent portions of the river. Chutes are the narrow passages of water between an island and the mainland. Where the channel of fastest flow crosses the river in passing from the outer bank of one meander to the outer bank of the next a crossing is established. Islands retain their name even after the chutes have been filled. A crevasse is a break in the levee system through which a swollen stream finds relief by discharge.

THE PLACE OF THE MISSISSIPPI IN RIVER CLASSIFICATION.—As a whole, the Mississippi River system is complex, and because of its heterogeneity it cannot be described in simple terms. That portion, however, which interests us runs, for the most part, on a coastal plain, and the river is consequent on the slope of the plain. The uplift of this coastal plain has extended the main trunk of the Mississippi and joined with the system the Arkansas, Red, and White Rivers as tributaries. There is strong evidence (Griswold, '95, 474) that a barrier to the southern drainage formerly existed at the Ozark Mountains, and that an interior sea in the west received the drainage north of these mountains. A warping of the barrier or a capture by the stream, consequent on the coastal plain, or both, turned the Upper Mississippi drainage southward. In this way the simple consequent river, engrafting the rivers now its southern tributaries and capturing the northern drainage, became the present complicated stream. The present sinking of the region about the mouth of the river tends to embay it, but the load of sediment which the Mississippi deposits builds out and up as fast as the land goes down and prevents the drowning. In any consideration of the age of the Mississippi it is again necessary to deal with the river in its parts. The tributaries of the river are in their youth. The main trunk of the river, the Lower Mississippi, has reached maturity, and is fairly well advanced in this stage.

NUMERICAL DATA.— The following is tabulated from various sources:

Distance from Cape Girardeau to Gulf, by water.....	1,700 miles
Distance from Cape Girardeau to Gulf, straight line..	600 miles
Entire area drained by the river.....	1,240,000 square miles

(Equivalent to one-third of the United States.)

Average annual precipitation over basin..... 29.8 inches
Annual discharge of water..... 785,190,000,000 cubic yards
Ratio of discharge to rainfall..... 0.25
Total amount of sediment, yearly..... 406,250,000 tons
Ratio of sediment to water by weight..... 1:3575
Average depth removed over drainage area..... .00223 inches
Annual discharge of sediment..... 7,459,267,200 cubic feet
Solid matter in solution, yearly..... 112,832,171 tons
Height of high water above Gulf at Cairo..... 322 feet
Height of low water above Gulf at Cairo..... 271 feet

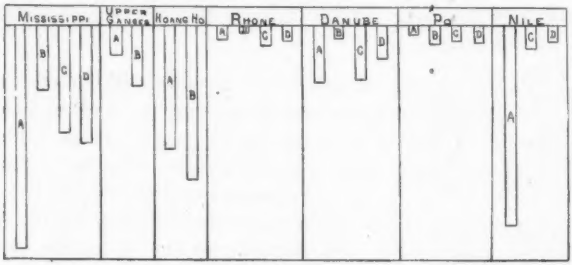


FIG. 2.

DRAINAGE AREA AND DISCHARGE OF THE MISSISSIPPI RIVER COMPARED WITH THE SAME FEATURES OF OTHER LARGE STREAMS:

A. Drainage area in sq miles 1/16 in. = 30,000 miles.
B. Annual discharge in cu. ft. 1/16 in. = 600,000,000 cu. ft. (Geikie).
C. Annual discharge in cu. ft. per sec. 1/16 in. = 30,000 cu. ft. (Babb).
D. Annual discharge in tons 1/16 in. = 19,000,000 tons.

The slope of the river is a varying quantity and diminishes as the Gulf is approached. A table of slope is sufficiently instructive to be included (Humphreys and Abbot, '61, 107).

STATION.	DISTANCE.	HIGH WATER.	LOW WATER.	DIFFERENCE.	RESULTING FALL PER MILE. TO	HIGH FEET.	LOW FEET.
	Mi.	Ft.	Ft.	Ft.			
Head of Passes	0	2.8	0.5	2.3	.....	....	....
Fort St. Philip	20	5.1	0.6	4.5	Head of Passes	0.115	0.005
Carrollton	104	15.3	0.9	14.4	Fort St. Philip	0.121	0.004
Donaldsonville	176	25.8	1.5	24.3	Carrollton	0.146	0.008
Baton Rouge	228	33.9	2.8	31.1	Donaldsonville	0.156	0.025
Red River Landing	299	49.5	5.2	44.3	Baton Rouge	0.222	0.034
Natchez	361	66	15	51	Red River Landing	0.266	0.158
Vicksburg	470	..	..	49	.....	....	....
Gaines Landing	630	149	..	..	Natchez	0.309	....
Napoleon	672	..	..	50	.....	....	....
Memphis	855	221	181	40	Gaines Landing	0.320	....
Columbus	1059	310	263	47	Memphis	0.436	0.402
Cairo	1080	322	271	51	Columbus	0.571	0.382
St. Louis	1253	408	371	37	Cairo	0.497	0.578

The slope of the river from St. Louis to Cairo is greater at low water than at high water. The explanation of this singular feature lies in the large volume of water poured into the Mississippi by the Ohio during a flood in this tributary. The discharge of the Ohio increases the slope south of Cairo and at the same time decreases the slope north of Cairo. Similar effects, though less well marked, may be observed from the floods of the other tributaries.

The velocity of the river is largely a function of the slope and the resistance. The Mississippi has a velocity ranging from 1 to 6 miles per hour. An average velocity in the lower part may be roughly stated as 4.2 feet per second (equivalent to 2.86 miles per hour). In any sectional area of a river the velocity of the water varies in different parts. The area of greatest velocity in a symmetrical cross section will not be near the bottom nor along the banks, where inequalities of floor or wall hinder the flow; nor at the surface, where atmospheric resistance is encountered. It will be somewhere below the surface, and probably nearer the top than the bottom of the sectional area. It has been determined by Humphreys and Abbot ('61, 302 *et seq.*) that the mid-depth velocity of any vertical plane is not far from the mean velocity. The ratio between the mid-depth velocity and the mean velocity increases slightly with the size of the stream. The mean of several mid-depth velocities taken at equidistant stations, the banks being considered two of them, will approximate very closely the mean velocity of the stream.

GENERAL SHAPE.—The river courses through an alluvial plain. The river's position has formed four smaller basins in the large basin of the Lower Mississippi—the St. Francis, extending from Cape Girardeau to Helena on the west of the trunk stream; the Yazoo, from Memphis to Vicksburg on the east; the Tensas, from New Madrid to the Red River on the west; and the Red River Basin continuing on the same side to the Gulf. The head of the alluvial plain is at Cape Girardeau, where the higher land of the upper river ceases. From Cape Girardeau to the Gulf the river touches the high lands on the west in two points only—New Madrid, Mo., and Helena, Ark.; while on the east at numerous points—Columbus and Hickman, Ky., the Chickasaw Bluffs, and various localities between Vicksburg and Baton Rouge.

A cross section of the flood-plain of the river (Fig 3) shows the normal features. The mean fall of the back slope of the flood-plain from the river averages about 7 feet in the first mile—the

minimum is about 4 feet in the first mile at Cairo, and the maximum 13 feet near Baton Rouge. In general, then, the amount of fall in the back slope of the flood-plain increases towards the mouth of the river.

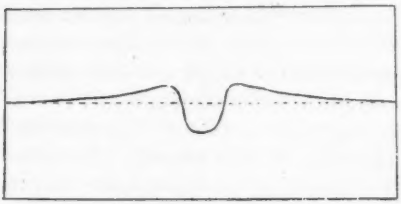


FIG. 3.

CROSS-SECTION OF FLOOD-PLAIN (VERTICALLY EXAGGERATED). DOTTED LINE REPRESENTS THE WATER LINE.

The river exhibits the general behaviour of meandering streams. Against the concave banks the river presses with force, and erosion is rapid. In addition, as the line of fastest current is delivered to the down valley side of every crossing, there results from these causes an increase in the radius of curvature of the meanders and the down-stream progress of them. This increase in the radius of curvature will account for many lakes with a radius of curvature larger than any existing meander. The lakes represent the largest curve that was attained in the meander stage. The increase of the curve is reflected in the outbuilding of the end of the lobe (toe-tap flood-plains) and the down-valley movement systematically develops the lobe on the down-river side (flood-plain scrolls, Fig. 1). When a cut-off occurs in the process of bank erosion the meander belt collapses (Fig. 1) to a minimum, and subsequent erosion tends to increase its width until another cut-off occurs.

TRIBUTARIES.—The tributaries of the Lower Mississippi are of three types:

(*a*) Rivers which flow directly across the flood-plain into the Mississippi. The Arkansas, White, and Red Rivers belong to this class.

(*b*) Rivers which run parallel to the main river for some distance before entering it. The St. Francis, Yazoo, Tensas, and Atchafalaya Rivers are the representatives of this type.

(*c*) Rivers which, because of the position of the Mississippi near the high lands, enter the trunk stream directly, crossing little or no part of the flood-plain. Many of the smaller tributaries on the east between Vicksburg and Baton Rouge belong here

A tributary, in order to belong with the first of these, must be strong enough to overcome the building of the flood-plain by the trunk stream. Many streams cannot do this, and these course down the valley in the depression of the flood-plain until the greater bar-

rier of the high land is encountered. Thus the St. Francis enters the Mississippi when it is a question between the higher lands at Helena and the flood-plain. The Yazoo is forced to enter under similar conditions at Vicksburg, where the Mississippi, after recrossing the basin, touches the higher land again on the east. The Tensas is cornered by the Red River. The Atchafalaya flows into the Gulf of Mexico, and does not enter the Mississippi at all.

CUTTING OF BANKS.—The deviation from a straight course by a river has been variously explained. The analogy with a fat man running down hill has been admitted in testimony (Mississippi River Floods, '98, 224). The man, it is maintained, knows that on account of the momentum it is unsafe to go down directly, so he zigzags down the slope, and the river unconsciously follows the conscious effort of the heavy-weight. In more usual terms Ferguson writes ('63, 322):

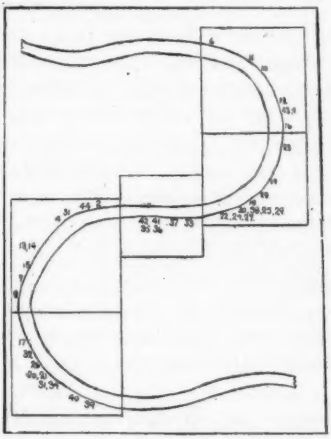
> A river is a body of water in unstable equilibrium, whose normal condition is that of motion down an inclined plane; and if we could abstract all the natural conditions of inequality of surface or of soil, it would flow continuously in a straight line; but any obstruction or inequality whatever necessarily induces an oscillation, and the action being continuous, the effects are cumulative, as those in a pendulum are discumulative; and the oscillation goes on increasing until it reaches the mean between the force of gravity tending to draw it in a straight line, and the force due to the obstruction tending to give it a direction at right angles to the former. If this be so it will immediately be perceived that the extent or radius of the curves will be directly proportional to the slope of the bed of the river.

A general law may be stated thus: A river on a flood-plain will deviate from a straight line because of obstructions. These obstructions include variations in the resistancy of the banks and the effects of the earth's rotation. Inequalities of surface or of soil alone will not suffice as an explanation. After a cut-off the river is comparatively straight along a limited portion of its course. What irregularities remain are gentle in curvature. The scour of the banks will begin at once to shape the curve into the true meander by decreasing the radius of curvature. When the meander stage is reached the increasing of the radius of curvature begins, so that the radius of the curve at the birth of the meander is the least, and at the time of the cut-off is the largest, curve that that meander attained. If this is true, while we may find some lakes with a smaller radius of curvature than some existing meanders, in the main the lakes will have a larger average radius. Eighteen lakes yield an average radius of curvature of 12,000 feet, and 13 meanders—taken consecutively—7,700 feet.

The rate and place of cutting may be obtained from a study of the river landings on the maps of the two surveys (Fig. 4). The landings occur along the steep banks of the river, where undercutting is rapid, and a steamer may thus approach near enough to the bank to allow a gang-plank to connect it with the shore. In 15 landings, 5 were found at the end of meanders and 10 on the up-river side of lobes. Every one of these had been moved between 1881 and 1894 from 1,000 to 5,000 feet. In each case the movement was away from the river, showing bank cutting. The 5 indicated the widening of the meander belt and the 10 the down-stream

LANDINGS.

1 Craigs.
2 Harwood.
3 Good Luck.
4 Linwood.
5 Eutaw.
6 Jenkins.
7 Gaines.
8 *Cypress.*
9 Stop.
10 Easton.
11 Glenora.
12 *Riverton,*
13 Bellevue.
14 Vancluse.
15 Monterey.
16 *Barnes.*
17 Luna.
18 *Longwood.*
19 Mound.
20 Sunnyside.
21 *Chicora.*
22 Tarpley.



LANDINGS.

23 *Bolivar.*
24 Glencoe.
25 *Buckridge.*
26 *Pilcher.*
27 Kentucky.
28 Carolina.
29 *Delohne.*
30 Utopia.
31 Curriola.
32 *Grand Lake.*
33 Home.
34 *Upper Leland.*
35 Warfield
36 Lake Washington.
37 Carter's Point.
38 Holly Ridge.
39 Chicot.
40 Point Comfort.
41 *Franklin.*
42 *Cat Fish.*
43 *Leota.*
44 *Sterling.*

FIG 4.

DISTRIBUTION OF LANDINGS ON MEANDERS FROM ROSEDALE TO SKIPWITH, SHEETS 13, 14, 15, 1900 SURVEY.

Landings in italics displaced by caving banks 1,000 feet or more.

progress of the meander. The average rate of movement of the 15 landings was 150 feet per year; the average annual rate of 27 localities tabulated in the Reports ('82, 162) yielded 100 feet. Marengo Bend (Fig. 5), near Natchez, illustrates the unstable conditions of the banks.

A further feature is shown by the 18 lakes. Seven of these are on the east, and have an average radius of curvature of 10,000 feet; and 11 are on the west, with an average radius of curvature of 13,000 feet. This has been explained by Ferrel's law, that a stream under the influence of the earth's rotation always tends to wear its right bank in the Northern Hemisphere. Gilbert ('84, 427) states

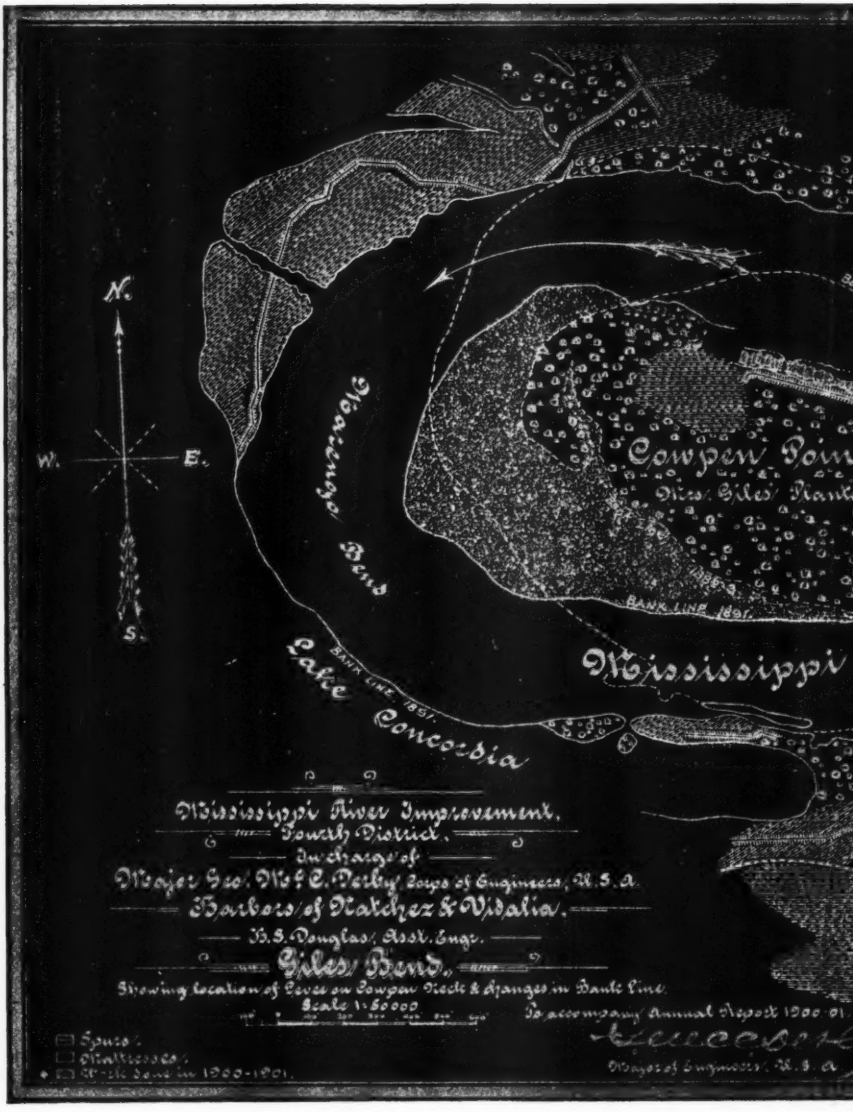

N.
W.
E.
S.
Giles' Bend
Lake Concordia
BANK LINE 1897
Mississippi
Mississippi River Improvement.
Vicksburg District.
In charge of
Major Geo. Mc E. Derby, Corps of Engineers, U.S.A.
Harbors of Natchez & Vidalia.
U.S. Douglas, Asst. Engr.
Giles' Bend.
Showing location of Levee on Cowpen Neck & Changes in Bank Line.
Scale 1:60000
To accompany Annual Report 1900-01
Major of Engineers, U.S.A.

FIG. 5.

Bank Line 1882-3
Giles Bend
Bank 1891
Bank Line June 1891
Bank Line 1882-3
Bank 1891
Bank Line June 1891
Bank Line 1882-3
Bank 1900-01

G. 5.

XUM

that the selective tendency in the case of the Mississippi is nearly 9% greater than towards the left bank. In the Connecticut River, Emerson ('98, 734) finds 7 cut-off oxbows on the west—right bank—and none on the east. If the deviation of Ferrel's law was alone operative it would be necessary to expect more lakes on the left (Fig. 6). At A the law induces a cut-off and at B opposes one. Other things being equal, A will cut through before B, and the lake will occur on the left bank. No satisfying explanation of the arrangement of lakes has been found. A stream in passing a bend is ponded until the resistance to the change of direction is overcome. The ponding will be greater in the sharper bend. It is likely that the sharper meanders, generally the east ones, in times of flood, oppose the passage of the volume of water sufficiently to allow a wash-over at the neck. This wash-over is a considerable factor in a cut-off, and, as the sharper bends are the east ones, the tendency of the river is to hasten a western oxbow lake.

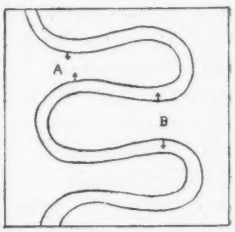


FIG. 6.

DEPOSITS.—The material corraded from the banks of the river may be carried down to add to the enormous pile that forms the delta of the Mississippi, or it may find a temporary resting-place over the broad flood-plain borne by some flood, or some of the minor depositions may be formed by it within the banks of the river. Many of the islands so numerous in the river have been formed in the quieter portions of the stream, and other islands are in the process of growth. Starting as a sand bar, driftwood finds anchorage upon it, and deposition is increased. A willow growth further aids its building during high water. Later, the chutes are filled and the island is joined to the mainland, to be at a later time, probably, destroyed by the river. Opposite the position of rapid cutting is a portion of the river flowing under a weakening activity, and consequently depositing. Here are formed the toe-taps and the scroll flood-plains which appear so frequently on the end and down-river side of the lobes. This work is in more active progress in the upper than the lower parts of the river, where it has comparatively ceased.

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CUT-OFFS.—The following list comprises most of the recorded cut-offs:

DATE.	NAME.	LENGTH.	
1722	Fausse River—Bunches	13 miles.	
1821	Needham's	11 miles.	
1831	Shreve's	18 miles.	Made by U. S. Engineers.
1848	Raccourci	21 miles.	Made by State of La.
1848	Horseshoe	8 miles.	
1858	American Bend	10 miles.	
1863	Napoleon		
1866	Terrapin Neck	14 miles.	
1867	Palmyra Bend	25 miles.	
1874	Council Bend		
1876	Centennial		
1876	City of Vicksburg	10 miles.	
1876	Devil's Elbow	25 miles.	
1884	Waterproof	12.5 miles.	

The rapidity with which a cut-off is made when no human agency hinders may be illustrated by quoting from Humphreys and Abbot ('61, 97):

> They (cut-offs) are believed to be likely to occur before many years at the neck above Napoleon, which was only 1,400 feet across in 1858, and caving badly; at the neck between Islands 98 and 101 (Terrapin), then reported to be 1,200 feet across and caving badly above; at the neck between Islands 105 and 110 (Palmyra), said to have been 10,000 feet across in 1808, and to be only 2,700 feet now (1858), and caving above; at the neck, between Islands 113 and 114 (Waterproof), caving badly above, and reported in 1858 to be only 2,400 feet across. There are other narrow necks—as those near Vicksburg and Grand Gulf, for instance—but there seems to be no reason to anticipate the early occurrence of cut-offs at them.

Five years later the river cut across at Napoleon; eight years later at Terrapin Neck; nine years later at Palmyra, and twenty-three years later at Waterproof. The Vicksburg cut-off occurred in eighteen years.

Mr. James (Reports, '82, 235) describes the occurrence of a cut-off:

> The event which has had more to do with the alteration of the level, and consequently of the general appearance, than any other phenomenon, not excepting the earthquakes of the early part of the century, was the Devil's Elbow cut-off in 1876. The writer hereof was at Shawnee Village, 10 to 12 miles away, and he distinctly felt the shock, and heard the roar of the mighty mass of water as the river cut its way through the narrow neck of land that had hitherto restrained it, and plunged at one leap down the descent which it had formerly crawled 25 miles to make.

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FIG

MAP OF COLES POINT, 1881 SURVEY. 1894 SURVEY IS ENTERED BY CONTINUOUS L
SCALE 1 INCH =

FIG. 7.

CONTINUOUS LINES. DOTTED LINES INDICATE SHOALING. HEAVY LINES REPRESENT LEVERS.
CALE 1 INCH = 7000 FT. APPROX.

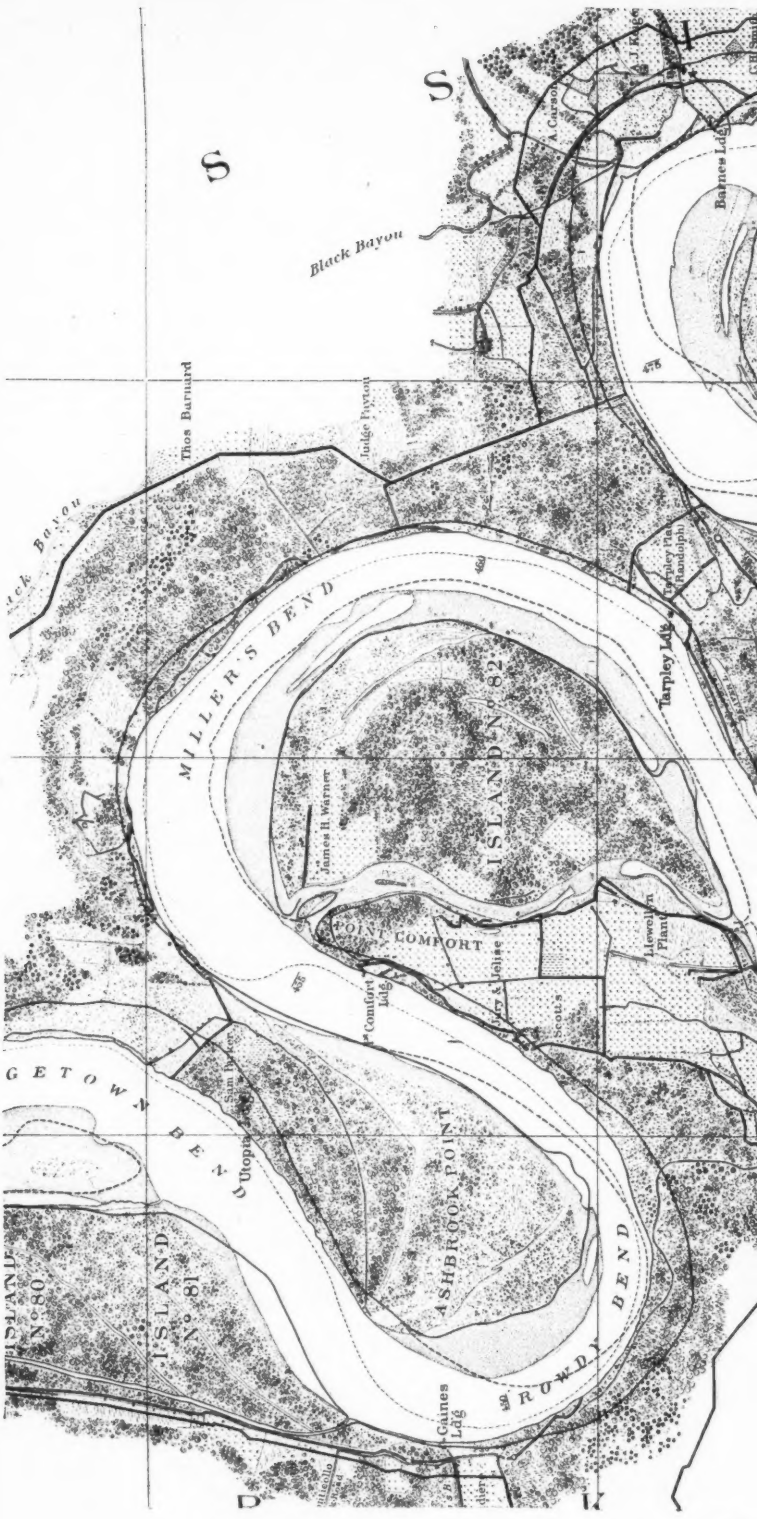

FIG.

1881 SURVEY. 1894 SURVEY IS ENTERED BY CONTINUOUS LINES. DOTTED LINES INDICA

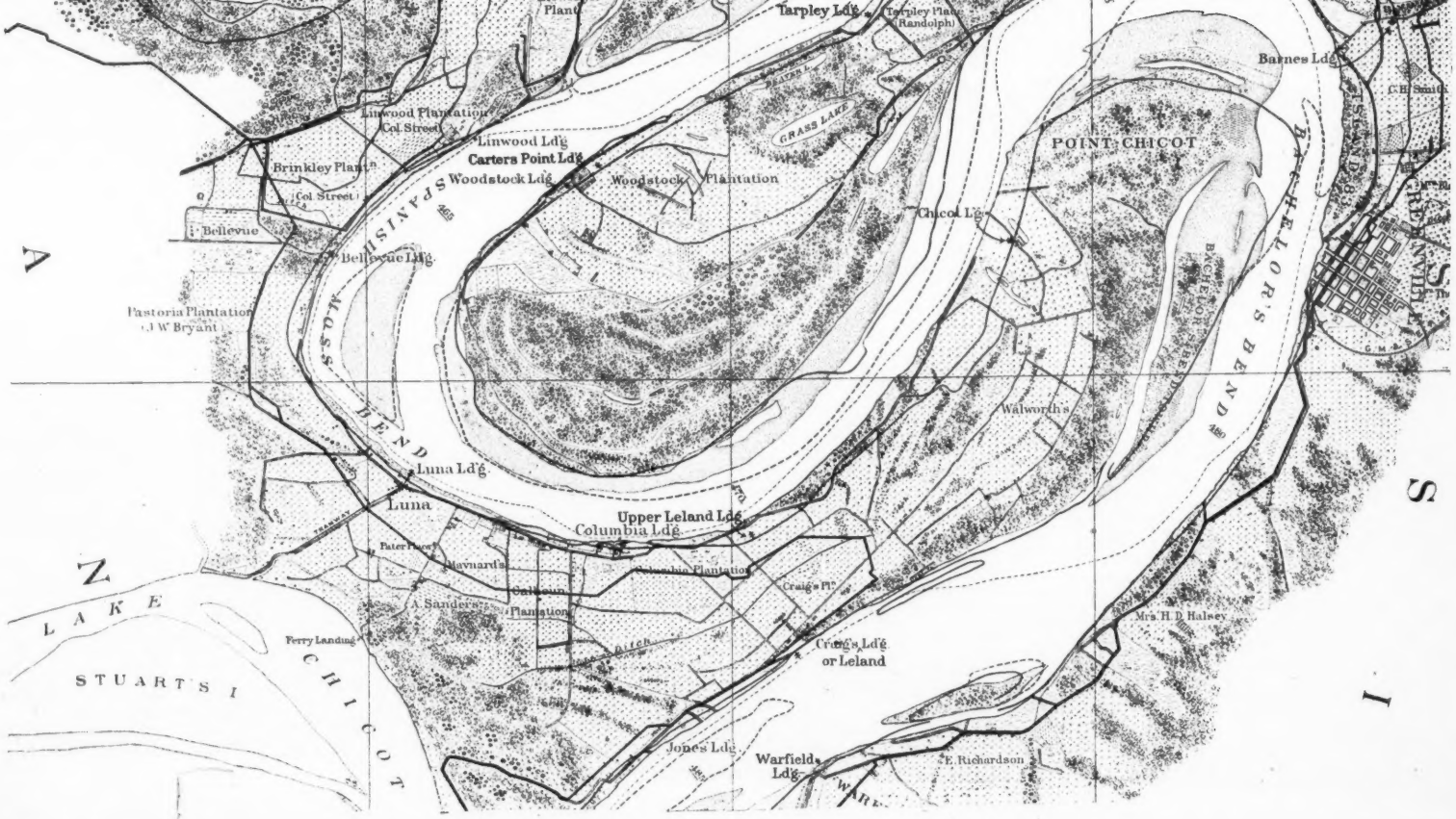

FIG. 8.

SHOWING LINES INDICATE SHOALING. HEAVY LINES REPRESENT LEVEES. SCALE 1 INCH=6,700 APPROX.

CHANGES CONSEQUENT ON CUT-OFFS.—Such have been the conditions following a cut-off that the engineers, almost in unison, cry out against their occurrence, and urge that all measures be used to prevent them. In the cut-off just described the immediate result was to check the rise in the river for 100 miles up stream. At Osceola, about 50 miles above, the river fell 22 inches in a few hours on a rising stream. Golden's Lake and the bottoms between it and Frenchmen's Bayou were drained. Young's and Carson's Lakes were lowered 4 to 6 feet. The water-level below a cut-off is raised. The increase of velocity, because of an increase of slope, increases the caving in the banks, both above and below its site. Waterproof cut-off occurred between the 1881 and the 1894 survey. The river before and after the occurrence is then open to comparison. Inspection of the results on the river banks (Fig. 7) shows that a new system of cutting and depositing is begun after a cut-off. The places of deposition may be termed "fills," and they are most highly developed in the bends leading to and from the deserted meander. Up and down stream from these on alternate sides of the stream they occur in diminishing prominence until they are lost in a more powerful action. Between the fills cutting occurs, and the river at once begins to regain its lost length.

Starling ('97, 2–4) disapproves of cut-offs because of the resulting instability. He states that in sixteen years after the Vicksburg cut-off, which shortened the river 6.5 miles, in a hundred miles the river had regained 4 miles:

> In 1825, from the Ohio to the mouth, the river was 954 miles; in 1882, 963 miles. In 1884 occurred the Waterproof cut-off, which shortened the river 12.5 miles. The distance in 1897 is about the same as in 1825. In seventy-two years, however, fourteen cut-offs have occurred, with a shortening of at least 160 miles.

The Greenville curves open both sides of the question. A cut-off is threatening at Ashbrook Point (Fig. 8). The neck at this point was, in 1883, over 4,000 feet wide; it is now less than 2,500 feet. Should a cut-off occur here others would be precipitated. Point Chicot, a short distance below, has a neck of only 3,000 feet. Greenville, on Bachelor's Bend, is even now struggling to maintain its position. The dike is standing to-day where was the centre of the town. By a system of leap-frog movements—the owners on the river bank building in the outskirts as fast as they are driven out by the cutting stream—the town has been kept on the alert, and its constant danger has not prevented its growth. Its population in 1880 was 2,191; in 1890, 6,658; and in 1900, 7,642. To protect this town the sum of $799,271.24 had been expended up to 1899,

and this does not include $42,277.10 contributed by the city itself in 1887; and the danger does not decrease. The Ashbrook Point cut-off will increase the cutting at Greenville and be a new source of alarm to the town, or a cut-off will be precipitated at Point Chicot neck, and Greenville be left two miles from the river. It is for the interest of Greenville to deplore both these events and to prevent further cutting by large outlays. Yet the place is doomed, and a sum of money, which probably exceeds the valuation of the town, has been expended in a hopeless fight. It is better to continue the outlay, in so uniting with the efforts of the river as to secure a gently curving channel, along the banks of which protection from caving may be relatively a simple task.

The engineer foresees in a cut-off at Ashbrook Point cut-offs in the two bends immediately below, which altogether would shorten the river at least 30 miles. The changes in the river banks would be enormous in extent and would continue for many years, or until the river had regained its length. Thus it has been regarded by the engineers as of prime importance that the Ashbrook cut-off should not occur. The plea of the merchant that the destruction or isolation of Greenville will be felt beyond the limits of the city itself, since an important commercial centre will then be lost or lose its geographical advantage, is not a valid argument for the national expenditure of large sums in order to delay an evil, nor is it an excuse for rearing a city in the face of such an event.

Cowpen Neck (Fig. 5) threatens a cut-off, and this occurrence will probably deposit sand along the Natchez front and destroy the harbour.

Bottom.—The bed of the river oscillates about a certain well-defined average condition, and is in a state of constant motion. Sand bars are deposited under the action of changing velocities, so that the bottom is a series of pools and shoals. In a constant velocity and volume of the stream a tendency towards the average condition results, and, as both these factors change, the departure from the average becomes marked. The rapidity of change intensifies the departure from the average condition, as the duration of constant flow aids the approach to the average.

The transportation of sediment along the bottom has been shown (Reports, '82, 88) to be carried on in a series of ridges of irregular shape, transverse to current direction. These ridges or waves attain their maximum size and speed at high water, and at the same time they approach a regularity of movement down stream. A rapid

increase in velocity or a corresponding decrease obliterates the waves by increasing the scour or forming shoals, but they reappear again as the current approaches uniformity. The advance of the wave and the transportation of sediment are carried on by the material rolling up on the up-river side of the ridge and depositing on the down-river side. A great deal of the load of a stream is transported in this way near the bottom.

(*To be continued.*)

THE VALLEY OF THE UPPER EUPHRATES RIVER AND ITS PEOPLE.*

BY

ELLSWORTH HUNTINGTON.

THE ASHIRETS OR CLANS—FEUDS.—Among the mountains the Kuzzilbash defy the Government, and know no law except that of the aghas of their own ashirets or tribes. Petty feuds are continually in progress, so that every one carries a gun, either an old flintlock or a modern Martini. At times of feud only the priestly class of Sehids are safe from attack, and so the business of conducting travellers and trains of pack animals is wholly in their hands. The Kurdish ashirets closely resemble the Scotch clans of four or five centuries ago. In September, 1901, I crossed their stronghold, Dersim, but was unable to penetrate into the very wildest part, because there were so many feuds in progress that even the Sehids dared not venture into such an excited region. The first noon our party reached Pertag, three miles north of the Euphrates River, at the foot of the southern range of Dersim, where a series of splendid clear, cold springs gush out from the hot white limestone mountains and embower the village in trees and vines. We had to wait an hour or two to get a new escort from the Government. While we were sitting on a little mattress, which the villagers with characteristic politeness had spread on the bare ground in the shade of the useful mulberry trees, and were enjoying one of the watermelons, with yellow flesh and brown seeds, which grow so well here on the irrigated terraces, a man, hot and breathless, came running up to the soldiers' quarters. There was hurrying here and there, taking down of guns, mounting of horses, and hastening away. A ragged cavalryman unwillingly stopped long enough to say that three or four hundred sheep and goats belonging to the village had been grazing on the mountain side an hour's journey away, when some Kuzzilbash came down and drove them off, just as the Scotch Highlanders used to raid the Lowlands long ago. One shepherd was killed and the rest fled. As we rode away from the village we passed groups of Turkish villagers going out with their guns to take vengeance on the Kurds, whose black tents we later saw in the distance. The next morning we passed a village whose

* Continued from BULLETIN No. 4, 1902.

Agha had lately been murdered at the instigation of a neighbouring Bey or feudal lord. The Agha's tribesmen were on the warpath ready to kill and rob at sight, so that our single escort was exceedingly nervous. We saw no further signs of violence, but the Government insisted on insuring our safety by furnishing us with an escort of from five to sixteen soldiers.

At another time, among the Zazas, I hired a guide to go a day's journey, but after a few hours he said that he must turn back and wanted his money. I insisted on his continuing with us in spite of his frequent appeals, until at last we came in sight of a distant village. Then he got down on his knees and implored me to let him go, because if the men of that village caught him they would surely shoot him. His distress was so genuine that I paid him off and dismissed him after making him tell why they would kill him. Some months before the guide's fellow-villagers had stolen a girl from the village before us and given her to one of their young men, so that now there is a deadly feud between the two villages. Such events are by no means rare, and even take place among Turks as well as Kurds.

THE FEUDAL BEYS, OR LORDS.—Besides the Ashirets, or clans, there are in certain places genuine feudal lords, called "Beys," who have absolute power over the villages around them. They are sometimes Turks and sometimes Kurds, and their serfs may belong to either of these races, or be Armenians. Except in the wilder mountain regions, where the Kurds still resist the Government, the power of the Beys has been broken. Where they are still semi-independent they treat their retainers rigorously, and are said even to put them to death, but will not allow any one else to misuse them. One morning one of these lords, whose guest I had been, gave me as guide a man whom he had obliged to work all day in the wheat field and to turn the winnowing machine all night, and who was now to go with me as far as I chose, which was not far. Yet, when a villager nearby stole a mule, and soldiers were sent to recover it, the thief's Bey called out his men and was ready to fight, but the governor thought it wise to let the matter drop. The Beys have as many feuds as do the Ashirets. One on whom I called, said:

"Oh yes, we fight more or less. I and my two brothers lose eight or ten men every year in fighting with our uncle in the next village."

Some of the houses, although built largely of mud, are more or less fortified. At the house of the man who gave me the tired

guide I slept on a mud roof—the most comfortable place in summer—which was surrounded by a thick mud wall, loopholed for musketry.

PATRIARCHAL GOVERNMENT AMONG THE NOMADS.—Another form of government, of which I have seen but little, prevails more or less among the nomadic Kurds—viz., the patriarchal. Most of the mountain Kurds are shepherds, and in summer leave their villages in the valleys and build booths of leaves, or pitch their black goats' hair tents high up beside some mountain spring. The real nomads, however, migrate from the plains of Mesopotamia to the mountains in the spring and back in the fall, and live all the time in coarse, black tents, which are doubtless the same as those used by Abraham four thousand years ago. The head of the family, the patriarch, puts up his tent in the best place, and all around are pitched those of his sons, nephews, and retainers. He entertains you right royally with bread, which the women bake on heated stones before the tent, with milk, either fresh or soured to a refreshing beverage, with cheese and butter churned in the early morning in a sheepskin suspended from a pole, and with the meat of a tender kid, which he pulls to pieces with his fingers, and then offers the fattest pieces to the foreigner—the guest of honour. He rules his people absolutely; but they seem to be happy and prosperous, and are free from all interference from outsiders.

THE FOUR STAGES OF CIVILIZATION AMONG THE KURDS—VIZ.: (1) THE PATRIARCHAL SYSTEM; (2) THE CLAN SYSTEM; (3) THE FEUDAL SYSTEM; (4) ABSOLUTE MONARCHY.—Thus among the Kurds four stages may be found, and each is more or less dependent on the physical environment, and in each the character of the people is somewhat different. Lowest in the scale of development are those nomadic shepherds who are under a patriarchal government. They live where rain is rare, and the air warm, and leave the mountains when the inclement winter approaches. They seem to be brave and happy, but have no incentive to progress, and their code of morals in the broader sense is utterly different from that of civilized races. Each large family is a law unto itself, and comes in contact with its neighbours but little. Strangers are received and entertained, but they are also robbed, betrayed, and killed.

Next come the Ashirets or clans, originally nomads, as it appears, whom invaders have driven into the remoter mountain valleys, whence it is difficult to migrate every year, and where the rigour of winter compels them to build permanent villages of mud

and stone. The old nomadic habit still persists, but now the migrations are of only a few miles—to the neighbouring mountains, and the fields in the valley bottoms around the villages can be cultivated even while the fat-tailed sheep are being cared for on the grassy uplands. The clansmen, like the nomads, gave me the impression of being light-hearted, brave, and happy, even though they are always in danger. Their loyalty is to the village and clan, and they have an intense love for their homes. It was one of these people who said to my servant:

"Why does this man come here and 'write the mountains'? We know that our land is the most beautiful in all the world. Does he want to tell his own people about it, so that they can come and take it?"

With the love for their homes has developed more of a sense of honour and responsibility than is found among the nomads. To be sure, they rob and kill at sight; but, nevertheless, their word can be relied on, and their hospitality is genuine.

Their care for their guests is shown by the somewhat misplaced kindness of an old Agha whom I visited three or four times at his lofty mountain camp. The first night when I went to bed he noticed that I not only took off my hat, but lay down to sleep without covering my head. He protested, saying that it was cold there on the mountains; the Kurds always kept on their turbans, and covered their heads, too; I should be sick. But I was obdurate. Sitting down on his mattress, at the foot of mine, he waited nearly half an hour, and then came and looked at me to see if I were asleep, which I pretended to be. That was what he wanted; getting a great quilt, three inches thick, he threw it over my head, and lay down to sleep, contented. He was determined that his guest should not suffer. I waited till he was quiet, and then pushed the quilt aside.

The next class, the feudal Kurds, are much like those of the Ashirets, but are often willing to take money for their hospitality—a thing which the others consider a deep disgrace. The Beys live near the edges of the mountains, and their people are largely employed in agriculture, although many sheep are kept. The serfs have learned the lesson of obedience, but it is to only one man.

The Kurds of the fourth class, who are under the absolute government of the Sultan, have learned the same lesson, although their obedience is not to one master, but to the many petty officials who make their life a burden. They live in the more accessible regions, and are avaricious, treacherous, and ignorant. The Ar-

menians have their quicker wits to help them: the Turks belong to the dominant race; but the Kurds are without protection, except as oppression goads them to resistance.

THE INFLUENCE OF ENVIRONMENT — ARCHAIC CUSTOMS. — The other two races, Turks and Armenians, live occasionally among the mountains, like the Kurds, but more commonly they keep to the plains. They have been often described, and are quite well known, but it may be of interest to describe a few traits, or habits, which illustrate either the influence of natural environment or the slowness with which old customs are laid aside. The external conditions of life have for thousands of years remained so uniform that there has been no incentive to progress and invention.

CHANGES IN LAKE GYULJUK AND THEIR EFFECT ON THE NEIGHBOURING VILLAGES. — An exception to the last statement, and at the same time a proof of its truth, is found in the region of Lake Gyuljuk, which has been already mentioned as lying in the neck of a great bend of the Euphrates River at the point where the Taurus Mountains are most passable. Although the narrow lake is now about twelve miles long and seven hundred feet deep, oral tradition and written record show that one or two thousand years ago its site was a plain, through which flowed a stream that disappeared by a subterranean outlet at the lower end. It appears that this outlet became clogged, and the water began to accumulate, forming a lake which year by year rose higher and higher, covering village after village, until finally the last village took refuge on a hill whose top was crowned by a monastery. Still the water rose higher; the hill became an island, and the villagers were obliged to take refuge on a broad gravelly fan delta opposite the island, on the mainland, at the foot of the steep mountains. In 1878, when the water had reached the monastery, it overflowed to the Tigris, and its rise was stopped. The poor villagers had lost their fertile fields, and, as almost no flat land remained, were obliged to satisfy themselves with the rugged mountain side, where a few terraces and less steep slopes were turned into wheatfields, while the steeper of the soil-covered slopes furnished a precarious foothold for vineyards. Even now the poor exiles complain bitterly of the greedy lake which has robbed them of their patrimony. The lake, however, was full of fish, which must be caught and used, since the scanty fields were unable to supply sufficient food. Some enterprising villagers from Gyuljuk, the largest village on the lake, and the only one inhabited by Armenians, went to Constantinople, and there learned how boats

are made. On returning, they built several—clumsy, to be sure, but immensely in advance of the primitive indigenous means of navigation. A few boats were built for neighbouring Kurdish villages; but these are now in ruins, partly because the Kurds are not so clever as the Armenians, and partly because the former have larger fields. The Armenian boats are kept in repair, and new ones are built. The fish are caught in nets at night.

During July, when the young fish, about five inches long, feed in great shoals along the shore, men, women, and children are busy catching them. A little rectangular pen of stones is built, extending three or four feet out from the shore, and at the ends of the outer wall two openings are left, outside one of which a net is placed so that it lies flat on the lake bottom, but can be raised so that the mouth covers the opening in the wall and the bag floats out behind. The innocent little fish come in through the openings, and are busily feeding, when they see two monstrous men before the only places of exit. One makes a great splashing, but the other seems quiet and harmless, so the fish all dash for the opening near the quiet man; but, alas! he has raised the net, and all the shiny little fellows are taken prisoner. They are put on strings and hung from racks on the flat mud roofs, where they remain all through August. In this hot, rainless season they dry without decomposing, and become like smoked herring. During August all the houses seem from a distance to be covered with great piles of brush, but an overwhelming odour forewarns the traveller of what he soon sees—that the brush bears fish, not leaves.

In still other ways the lake has changed the habits of the people. Thousands of birds frequent it—ducks, plover, gulls, pelicans, storks, and snipe—and are sometimes caught. On an island a few acres in extent, at the east end of the lake, among the rocks of a deserted and ruined Kurdish village, thousands of gulls lay their eggs, and furnish the people with a very cheap article of diet during May. Then, too, the people of Gyuljuk are far more in touch with the world than are their neighbours a few miles away, because of the visitors who come to the lake. Some day, under more favourable conditions, the beauty of the despised lake will make the villagers rich.

Primitive Modes of Travel on the Rivers.—On Assyrian monuments of 1000 B. C., or older, there are representations of rafts made of inflated sheepskins, and of men crossing the water on single inflated skins, with which they supported their bodies, while they swam with their feet. At the present time such rafts

are the only means of navigation on the Euphrates River and its branches, except at some of the larger ferries. No attempt is made to go up stream, although in summer the current is very slow in many places. For thousands of years the habits of the people have remained unaltered. When they wish to cross the river to market a raft of skins is sufficient for the men, and the animals can swim alongside. If the river is high and dangerous, business can wait a week or two. In 1901 I floated two hundred and fifty miles on such rafts and saw no other means of locomotion, with the exception already noted. To be sure, I saw a raft of logs, on which sat almost naked Kurds, with strings of dried gourds around their waists for life-preservers and wooden tridents for paddles. But this was not a means of transportation; it was merely the easiest way of getting the logs to the place where they were to be used. At the main ferries there is what I suppose to be a relatively modern innovation in the shape of exceedingly clumsy, square-cornered wooden boats. They are low in front, in order that animals and, in the few cases where wagon roads have been built, wagons may enter. The stern is high and overhanging, with a high platform, on which stands the steersman, who manipulates the mighty rudder, which is as long as the boat. Two rough planks, with rounded handles, are tied to pins close to the front of the boat, and serve as oars. Of course these boats are carried far down stream before they can reach the opposite side, and have to be towed up stream along the bank—a very long and tedious process. Occasionally they are carried several miles down stream, or get stuck on sand bars in the middle of the swollen river.

Attitude towards Foreigners.—Another mark of the primitive character of the people is their suspicion of foreigners, who are known as "hat-wearers." In floating down the Euphrates River with two American companions we passed Maden, the seat of a local governor. The advent of foreigners is so rare that the fact of our having floated past the town was reported to this official, who, in turn, telegraphed the news to the palace in Constantinople, and asked for instructions. From the Palace a message was at once sent, not to the local governor but to the Governor-General, telling him to find out who the "hat-wearers" were and what they wanted.

We floated down the river, because it was an opportunity for new exploration, and held out a promise, amply fulfilled, of affording interesting geological results, fine scenery, and novel experience. The people could not understand this, and failed to see why any one should

make such a dangerous journey, and especially why any one should all the time take notes about them, as they supposed. Accordingly, with true Oriental logic, they concluded that we had some secret purpose which must be opposed to their interests. Our own servants were equally unable to understand our purpose, although we tried to explain. I often heard them telling inquisitive villagers that they did not know what we were doing: "Perhaps they are going to make a bridge or a railroad. More likely they have a secret commission from the king. They say they are not paid for making this journey, but we know better; they are not such fools as all that. They know everything; they even know what is in a place before they have visited it."

This unlettered people's idea of geography consists in knowing the roads over which one has travelled; and they cannot understand how a man can know about a place that he has never seen, or why he should want to know, unless he expects to go there soon. These ideas about foreigners are almost the same as those which prevailed when Xenophon passed this way. America, England, France, Germany, are small cities, not nearly so important as Constantinople, near which they are located. All foreigners, or "Franks," are rich and live without working; they only come to Turkey in order to get richer and to make that country so much the poorer.

POTTERY-MAKING—A MONOPOLY.—Until the recent introduction of cheap European goods each village made most of the articles which its people required. The more difficult trades were carried on in the provincial capitals and other small cities, whose artisans often spent half the year in itinerating from village to village, taking their pay in grain, or butter and cheese. A few trades, however, such as pottery-making, have from time immemorial been restricted to certain villages. The village of Uslu makes most of the coarse red pottery used in the district, and attempts to keep a monopoly of the business, although good clay is found in other places. The women do all the pottery-making, while the men till the fields; and it is considered a disgrace for any man to be seen turning the potter's wheels, which are set under little sheds in front of every house. No girl is allowed to learn the art until she is married, for she might marry someone from another village, and so the monopoly would be destroyed. After a girl is married, and has learned to make pottery, she is compelled to remain in Uslu.

THE CUSTOM OF SACRIFICE—A REMNANT OF PAGANISM.—One more strange custom, common to Mohammedan Turks, Shiah Kurds, and Christian Armenians, is that of sacrifice—a remnant of the religion that preceded Christianity and Mohammedanism. One of the many places where sacrifices are offered, and the largest of the four or five that I have seen, is on Mushar mountain, close to the Euphrates River, opposite Malatia. Here, in a small cave, said to be the grave of a man called Hassan, a room has been made with mud walls, and has been furnished with many gaudy and some valuable offerings. Outside is a great square altar of rough stones, all covered with the gore of the scores of annual sacrifices slaughtered here by both Christians and Mohammedans, and cooked in huge copper caldrons hung from great beams. The horns are piled on another great altar, and the meat is often eaten at a sacrificial feast in the holy place, where the bones are thrown into a filthy little cave back of the main room. The shrine has no guardian, but is regarded with such veneration by men of all religions that the most valuable offerings are perfectly safe from pillagers.

Some distance below this shrine is another, the grave of a Christian girl, around which the Aghas of the Kuzzilbash village, at the foot of the mountain, are privileged to be buried, although the common people must lay their dead near the village. Close by is a large bush covered with fluttering rags. My Armenian servant tore a little strip from the bottom of his short striped tunic and tied it with the other rags.

"Are you sick?" I asked.

"Oh, no, but I may have a pain some day, and this will drive it away."

Such holy trees or bushes are found everywhere by the roadside or on hilltops, as are also great piles of stones, on which the pious traveller throws a pebble and thus gains credit in heaven.

Mohammedan cemeteries—those most dismal, repellent, verdureless wastes of stones—are located close to the roads, because, as my interpreter said, when I was first in the country, the people want to be buried near the road, so that every passer-by may "tell a pray" (say a prayer) for them.

Even among townsfolk superstitious practices are very common. One night in Harput I heard what seemed to be the sound of merry-making in a house nearby. All through the night drums were beat, fifes were blown, and there was high, shrill singing and clapping of hands in time to it. In the morning inquiry was made as to whether the cause of the festivities was a marriage, a funeral, a

christening, or a simple feast. It proved to be something much more unusual. Some weeks before a woman and her boy had been bitten by a mad dog, and the woman had already died, although the boy showed no signs of sickness. That day, being the fortieth since he was bitten, was considered critical, so in the evening all the friends of the family gathered with drums and other preparations for a good time. One would naturally suppose that they had come together to rejoice because the boy was still living, or else to mourn because the mother had died; but their purpose was nothing of the kind. They came to keep the boy from falling asleep, because their superstitious belief is that if a person who has been bitten by a mad dog sleeps on the fortieth night after the event he will surely die. If he does not sleep he is safe. The boy did not sleep that night.

Such are a few of the characteristics of the people and land where the great River Euphrates reaches its full size. It is a land of great natural beauty and wonderful resources—a land combining in a rare degree the advantages of a superb climate, splendid though much-abused opportunities for agriculture, mountains full of ore for the miner, and streams which might furnish immense water-power for the manufacturer. Yet, in spite of all these advantages, two thirds of the people are scarcely more enlightened than they were 2,000 years ago. It is the living, not the dead, who need that the traveller "tell a pray" for them.

VARIETIES OF TIDES.

BY

ALEXANDER BROWNLIE.

In the article on The Tides of the Pacific Ocean* we called attention to the remarkable fact that tidal action in the North Pacific is absolutely different from that in the South in the very important matter of time-intervals from one high water to the next; the difference is so great that they form two distinct types. In the South the time-intervals are exceedingly regular, whereas in the North they are exceedingly irregular, so in the two sections of the one ocean there are two distinct varieties, wholly unlike each other in their actions.

In the present article we draw attention to a few more cases of variation exhibited in other seas, and show the seeming cause to which the variation is due.

In tidal variation, besides the matter of exceedingly irregular time-intervals, another still more remarkable feature is the failure of flood-tide itself. Commonly, only one of the daily floods will disappear, and that failure continues for a longer or shorter period of time; but at much rarer intervals both disappear completely, and in that event we have the extraordinary spectacle of local sea-level remaining stationary for an entire day.

Now, the science of the tides makes no provision for such failures. Indeed, according to its fundamental doctrines, there ought to be no failure; for, as the moon never falters in its movements, so the tides ought not to fail in theirs. The fact is, however, that failures are not only of frequent occurrence but they exhibit themselves in wide regions of the ocean. For example:

The Gulf of Mexico Variety.

In the Gulf variety at Galveston, Texas †,

One	flood	fails	to rise	127	times,	according	to the tables,	in 1898.
"	"	"		165	"	"	"	1899.
"	"	"		217	"	"	"	1900.
"	"	"		139	"	"	"	1902.

* April, 1902, Bulletin Am. Geographical Society, N. Y.

† The United States Tide Tables for Galveston.

During the remainder of each of the given years the forecast for that port is two floods daily,* with the exception of a few days in which both disappear completely—viz., four days in 1900 and two days in 1902. From all this it is clear that the Gulf variety is absolutely distinct from the Atlantic type.

In the Atlantic we find no record of failures. Yet tidal energy enters the Gulf from the Atlantic, with the remarkable result that the thing reproduced bears only a kind of half resemblance to that which produces it. But the fact of a permanent variety existing in the Gulf, absolutely different in its action from that of the Atlantic, points with irresistible force to the conclusion that it is due to a local cause. If this conclusion were erroneous then this variety would not be in existence, for the type of the greater sea would reappear in the smaller; its existence, therefore, proves clearly that the variation is developed within the Gulf itself, and that it is due wholly to local environment. If this is true in one case, then tidal action may be controlled by the same principle in every case. And that is just what we find; we find it everywhere working in and proceeding from local centres, and not in the form of a globe-travelling wave.

At Galveston there is also a very wide range in the time-intervals from one high water to the next. The widest range, of course, occurs at the periods when one of the floods fails to rise, and then the great range of upwards of twenty-four hours is of very frequent occurrence.†

Now, so wide a range is not in accord with the lunar theory; for, according to it, the movements of flood tide ought to keep step with the movements of the moon.

But the fact of great irregularity, coupled with the notable fact of frequent failures, renders that theory untenable.

As may be seen in the above table, these failures in the Gulf vary greatly from year to year; it is likewise true that they vary from month to month; they also occur in all the phases of the moon; they take place as frequently when the moon is new or full as when it is in 1st and 3d quarters—thus showing clearly that the moon may be left out of the question with entire safety if we seek to solve the problem by TIDAL OBSERVATION alone, and by that method only can practical forecasts be made (*The Tides*, pp. 193, 194, 200).

* The difference between flood and ebb frequently is only two or three inches; at such times there is practically but one ebb and one flood per day.

† U. S. Tide Tables.

It is also a matter of observation at Galveston that the height to which tides rise is not unfrequently about the same in all the phases of the moon. For instance:

PHASES OF THE MOON.			PREDICTED RISE IN FEET AND TENTHS.	TIME.
New	1st Quarter	Full	each 0.9	February, 1902
New	3d "		" 0.9	March "
	1st "		1.0	" "
		"	0.8	" "
	1st & 3d Quarter	"	" 1 0	April "
New			1.1	" "
New		"	" 1.1	May "
	1st Quarter		1.0	" "
	" "		1.0	June "
		"	1.1	" "
	3d "	"	" 0 9	August "
New	" "		" 0.9	September "
New	" "		" 1.0	October "

It will be observed from the table that the height of the rise is altogether contrary to the rule of the theory; for, according to it, if new or full moon can raise water one foot in height, then 1st and 3d quarters ought to raise it only four inches. But in reality, when the waters of the Gulf rise as high at the quarters as at new and full, then the observed fact points to the conclusion that the moon has nothing to do with it. And if the facts of the case disprove the claim of the lunar scientist, what, then, is the cause of the Gulf variety?

We have already put on record our conclusion that variation is due to local environment. In the case of the Gulf it is clearly due to geographical environment; and in examining the environment it will be seen that the Gulf has two lines of communication with the ocean. These openings are not only comparatively close to one another—for they are situated in the southeasterly corner—but they are very small compared with the vast body of the Gulf.

Roughly speaking, the Strait of Florida and the Yucatan Channel are each about 100 miles wide, but the Gulf itself measures 1,000 miles by 600. From these figures it would appear that the supply of flood tide is very small for so vast a body, and that supply is delivered from the two sources at about the same time.

The supplies are also delivered at right angles to one another; hence the two lines of pressure must speedily come into collision. In fact, a clashing of the two forces is inevitable, and the result is a higher range of floods in that part of the Gulf east of the line of collision.

The highest rise occurs on the western coast of Florida. At Cape Romano and Apalachee Bay the mean is about 2½ feet. On northwest Cuba the range is much less, but at the entrances it amounts to only 1 foot 2 at Key West, Cape San Antonio, and Cape Catoche.

Everywhere else the rise is exceedingly small. On the extreme west of Florida, at Pensacola Bay, sea-level is almost stationary, the mean rise being only one inch. In fact, these small flood tides begin still farther east—at Cape San Blas, and from thence around the Gulf to the Bay of Campeche. The mean range is from one tenth of one foot to six inches at the great majority of the stations. That is to say, two thirds of the whole contour of the Gulf forms a region of exceedingly small tides.

The observed facts in the case of this variety show conclusively that the small rise, in so large a region, is due to the environment; that environment not only grants a short supply, but gives it a direction which leads to a collision of pressures.

The Yucatan Channel supply is directed northerly where the Gulf is 600 miles broad, and the Strait of Florida supply is directed westerly where it is 1,000 miles long.

These two lines of pressure, being delivered about the same time and in close proximity to one another, soon clash, with the result that the divergence caused by the greatest pressure shows itself in the largest rise on the coast of Florida, whereas all beyond this region of colliding forces becomes a region of exceedingly small tides—so small, indeed, as to escape the notice of an ordinary observer.

There remains for us to notice only one more well-known physical feature of the Gulf—that is, its currents. A perennial oceanic current enters through the Yucatan Channel and leaves the Gulf by the Strait of Florida; but even if that factor were absent, this variety would still remain absolutely distinct from the type of the Atlantic because of its geographical environment.

This variety does not extend to Key West. That port follows the type of the Atlantic with two floods daily, but the time-intervals are far from being as regular as they are in the Atlantic. For instance,

in the tables for January, 1902, we find the following extreme range in the times between one high water and the next:

	HOUR.	MIN.		HOUR.	MIN.
Forecasts for Key West...	11	07	to	13	47
" " Charleston...	12	13	"	12	52
" " Sandy Hook..	12	09	"	12	47

By the table it will be seen that while the extreme variation at Charleston and Sandy Hook is only 39 minutes, it is 2 hours 40 minutes at Key West.

SKETCH MAP OF THE GULF of MEXICO SHOWING THE MEETING PLACE OF TIDAL PRESSURES FROM THE TWO SOURCES OF SUPPLY AND THEREBY EXPLAINING THE CAUSE OF THE VARIATION IN TIDES. THE FIGURES GIVE HEIGHT OF RISE IN FEET AND TENTHS. THE ARROWS SHOW THE TREND OF THE PRESSURES.

Sea of Java Variety.

At Batavia, Java, the most remarkable feature of this variety is the frequency of the failure of flood tide. In fact, the failure of one

daily flood forms the rule and days with two floods the exception. For instance:

There are 38 days with two floods, according to the tables in 1898*
" 41 " " " 1899
" 32 " " " 1900
" 15 " " " 1902

In the above table we take no notice of enumerated floods where the difference between flood and ebb amounts to only two tenths of an inch, for then practically there is no visible change of sea-level.

It is on record that for weeks at a time currents have flowed through the Strait of Sunda. Then for a similar length of time they have flowed back again without showing any perceptible rise or fall of sea-level. †

Moreover, in the forecasts for Batavia in the four years named there are fifteen days in which both floods disappear completely. And at this port it not infrequently happens that floods rise as high, or even higher, at the quarters than at new moon or full. For instance:

3d Quarter,	2 feet 4	New, 2.3	Full, 2.6	Feb.,	1898
" "	2 " 5	" 1.9	" 2.1	Mar.,	"
" "	2 " 7	" 2.6	" 2.3	Apr.,	"
1st "	2 " 6	" 1.9	" 2.1	Sept.,	"
" "	2 " 5	" 2.3	" 2.7	Oct.,	"
3d "	2 " 8		" 2.7	Feb.,	1899
" "	2 " 9	" 2.3	" 2.4	Mar.,	"
" "	3 " 0	" 2.9		Apr.,	"
1st "	3 " 0	" 2.3	" 2.2	Sept.,	"
" "	3 " 0	" 2.6		Oct.,	"

The heights of rise at the quarters, given in the above table, make a remarkable commentary upon the seventeenth century science. And, in view of the failures of that science, it is to-day worthless for practical forecasting, for these cannot be made by a knowledge of the science only; but they can be made more or less correctly by observation at any place, and that, too, by men who have no knowledge of the science whatever. (See our reference to *The Tides*, page 2 of this article.)

The sea of Java has several openings communicating with the ocean; but the largest of these lead into other enclosed seas, and in this larger local environment must be sought the full explanation of all the vagaries of the variety.

The Manila Variety.

At Manila (Corregidor Island), according to the tables for 1902, only about one hundred days in that year have two floods. During

* U. S. Tide Tables for Batavia.

† London Shipping World.

the remainder of the year, practically speaking, there is but one daily, excepting a few days when there is none at all.

Bering Sea Variety.

What we have to say regarding this variety refers to observations taken at St. Michael, Norton Sound. They were taken during the open season for navigation, June to October, and in these five months, according to our tables,

37 days have two floods in 1900
39 " " " " " 1902

During the remainder of the season there is but one daily, excepting a few days in which there is none.

One peculiar feature in this variety is the great number of failures in June and July. In these months two floods occur only upon one or two days each.

The environment of this variety is peculiar, in that it lies between two more varieties, whose communications are nearly closed on one side—viz., the North Pacific Ocean and that region of the Arctic immediately adjoining Bering Strait.

At St. Michael gales are of frequent occurrence during autumn, and when a strong one blows from the north for several days, sea-level may fall as much as five feet below mean low water.*

Both the Manila and Bering Sea varieties are only recent additions in the U. S. Tide Tables, and we have no information as to their extent beyond the small spots where they are now observed.

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* U. S. Tide Tables for St. Michael, 1902, p. 165.

(*To be continued.*)

PORTO RICO—ITS CLIMATE AND RESOURCES.

BY

WILLIAM A. ALEXANDER.

1. CLIMATE.—The geography, especially the orography, of a country constitutes such an important factor in any basis upon which to build an intelligent discussion or knowledge of the climate, that the reader is urged to precede or accompany a consideration of this discussion with a careful study of a good map of the island. Note first the latitude and longitude, and then observe that the island is rudely rectangular, the greater axis lying almost exactly east and west, and is about one hundred miles in length and thirty-six miles wide, and therefore contains about three thousand six hundred square miles. Note also the existence of a well-defined water-shed beginning near the little town of Maricao, just north of San German, in the southwest corner of the island, and extending eastward so as to conform very closely to the southern and eastern coast lines, and terminating in the famous peak El Yunque. This ridge varies in height from two thousand to four thousand feet, and is so situated as to divide the island into two unequal parts, about one third being on the south side and two thirds on the north side. Both sides of this ridge are deeply corrugated with alternating cliffs and gorges, and many streams—some very properly called rivers—find their way to the sea.

With these data in mind, we are prepared more fully to consider the climatic features of the island.

The climate of Porto Rico is, of course, tropical, but the topography creates decided local climatic differences. These climatic changes when expressed in words or figures appear very insignificant, but to the native or one who has become acclimatized they are decidedly appreciable. In fact, one may hear the native Porto Rican speak of the "rigours of winter," which to one used to northern winters seems amusing; but to one well acquainted with the facts it is not surprising.

Considering now the ordinary daily changes in temperature, we note that the lowest temperature for the day occurs between five and six in the morning; after this hour it rapidly increases up to 10 A. M., and then remains nearly stationary until 1 or 2 P. M., after which it gradually falls until 5 A. M. the next day. The maximum usually occurs about 2 A. M., but may occur any time between

10 A. M. and 2 P. M. The mean daily range—that is, the difference between the maximum and the minimum temperatures—is quite constant throughout the year, but varies at different stations over the island, depending upon location and local surroundings. The figures given are taken from the records at the local office of the U. S. Weather Bureau, at San Juan, and are applicable only to San Juan, but they serve to show the marked regularity which characterizes the climate of Porto Rico. The mean daily change of temperature at San Juan is 11.5° F., taking an average for the year; while there is less than 2° difference in the mean for the various months. The inland and mountainous districts have a daily range of from 13° to 23°. These daily temperature changes are, of course, subject to sudden but temporary fluctuations, as during the passage of a thunderstorm, when there may be a drop of 8° to 15° in the temperature.

As regards the yearly changes of temperature, it will be observed from the accompanying table of meteorological data, taken from the records of the U. S. Weather Bureau, that the month of January has the lowest mean temperature, while that of February and March is but slightly higher, and all three have very nearly the same minimum. The mean temperature gradually increases from March to August, and then begins to decrease. Although the month of August has the highest mean, it will be observed that the highest temperature for the year occurred in May. In 1900, the highest, 93°, occurred in April; and in 1889, the highest, 91°, occurred in June and September. It is also interesting to note that although August has the highest mean, September has the highest "mean maximum," and that the difference between the highest temperature for the year, 93°, and the lowest, 67°, is 26°, while the difference between the highest mean, 80.4°, and the lowest, 75.2°, is only 5.2°, all of which go to show the erratic nature of this climatic feature within its narrow limits.

As before stated, the various sections of the island experience different degrees of heat, depending upon local conditions, but a temperature of 100° is very rare. In fact, such a temperature has not occurred at San Juan since the establishment of the U. S. Weather Bureau office in 1898, and has been reported from other stations on the island but twice within that time—once from Cayey and once from Comerio in 1901. A temperature as low as 50° is occasionally reported from stations situated upon the mountains. Thus the island really has a range of 50°. The decrease of temperature with elevation is about 4° for each 1,000 feet of ascent.

The relative humidity of the atmosphere is at all times very high, and it is subject to the same regular daily changes, but, of course, just the reverse of the temperature changes. That is to say, the humidity is highest about 5 A.M., and then decreases rather rapidly until midday, when it begins to increase gradually until 5 A.M. the next day. This constant high humidity is very trying on the health of persons used to cold climates. The prevailing winds are easterly, and are fresh to brisk during the day and light during the night. These winds are the northeast trades, modified more or less by local conditions, and they constitute a most fortunate feature of Porto Rican climate.

TABLE I.

METEOROLOGICAL DATA RELATIVE TO SAN JUAN, PORTO RICO.

	TEMPERATURE.					MEAN RAINFALL.
	MEAN.	MAX.	MEAN MAX.	MIN.	MEAN MAX.	
January.....	75.2	84	81.6	67	69.9	2.97
February....	75.6	89	83.3	67	70.7	2.37
March.....	75.6	87	82.7	67	70.9	2.32
April.....	77.1	90	84.8	70	72.5	3.59
May	78.8	93	86.3	70	74.0	4.67
June.....	79.2	90	85.7	70	74.6	4.87
July.....	79.9	89	85.0	70	74.6	5.74
August	80.4	91	86.9	70	75.4	5.87
September...	80.3	92	87.2	71	75.4	5.13
October.....	79.0	88	86.3	71	74.5	6.18
November...	78.2	89	84.0	70	72.7	6.50
December ...	76.5	86	82.4	68	71.5	4.30
YEAR.....	78.0	93	84.7	67	73.1	54.50

The mean temperatures are based upon a three years' record, but the figures relative to the maximum and minimum temperatures are those of 1901.

Coming now to the question of rainfall, let it first be understood that Porto Rico has no "dry" and "wet" seasons in the sense that at certain times of the year the rains set in and continue uninterruptedly for a season, giving us the wet, dreary days common in parts of the United States, when one does not dare to venture out. Such weather is absolutely unknown in Porto Rico. The only difference between the fall of one part of the year and another is in

the amount of the fall. The rain falls in quick, sharp showers, more like a "spring shower" in the United States. The clouds often appear suddenly, the rain falls rapidly, and at times in great quantities, but the shower soon passes over, and the weather is as fine as a spring morning. This is true the year round.

By reference to the table above mentioned, as well as to Figure 1, a very correct idea of the rainfall of the island may be had. The data in the table apply to San Juan, but the graphic presentation in the figure gives the true distribution through the year for any

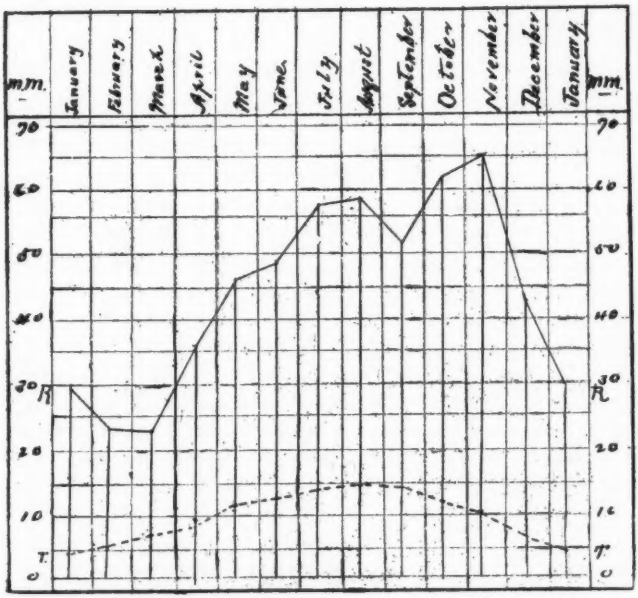


FIG. 1.—*R.* Graphic presentation of the average monthly rainfall at San Juan, P. R., based upon twenty-six years' record. *T.* This line represents the departure of the monthly mean temperature from the annual mean, supposing line "10-10" to represent the annual mean, 78.0° F. Scale used: 1mm=0.10 inch of rain, or ½ degree of temperature.

part of the island. As will be seen, the months of January, February, and March have the least averages, and October and November the greatest. Note the gradual increase in the monthly averages from March to November (excepting September, when a very curious drop occurs) and the rapid decline after November.

As intimated, the rainfall is not evenly distributed over the island. In the neighbourhood of Luquillo, in the northeastern portion of the island, there is a yearly fall of more than 150 inches;

while along the central, elevated portions a fall of more than 100 inches is not uncommon. That portion of the island south of the water-shed receives the least rain, the average for the district being a little less than 50 inches; while many places often experience severe drouths, rendering irrigation quite necessary. North of this divide the fall is heavier and more constant. The average for San Juan, 54.50 inches, may be taken as fairly representative of this section.

The rains fall almost daily; but evaporation is very rapid during the day, and consequently the showers which fall at night are the most beneficial. The rains are about equally divided between the day and night.

II.—RESOURCES.—Practically all the industries of the island, as well as the principal sources of wealth, come under one of the following heads—viz., Agriculture, Stock-raising, Manufacturing, and Mining. There is some cutting of timber, but this is not considerable. So we will consider these heads separately and in detail.

1. AGRICULTURE.—Using this term to include fruit-growing, this industry at once far surpasses all others in importance. In fact, it is the mainstay of the island and the support of the great majority of the inhabitants. Almost all available land is now under cultivation, and even the hill and mountain sides are being planted in crops. The lowlands, or playas, lying between sea and mountain, and the river valleys, constitute by far the most valuable agricultural lands. According to the census of 1899, there were then in the island 39,021 farms, with an average of 45 acres to the farm; but an average of only 12 acres per farm was in cultivation, the rest being devoted to pasture.

We take from the Report of the Commissioner of the Interior for Porto Rico, 1900–1901, the following facts as to how the lands of the islands are employed for agricultural and other purposes:

Sugar cane	82,678 acres
Coffee	166,164 acres
Tobacco	13,704 acres
Miscellaneous crops	201,815 acres
Pasturage	1,203,206 acres
Woodland	165,671 acres
Uncultivated lands	138,348 acres
Total	1,971,586 acres

At least three fourths of the island is in farms, and certainly as much as one fifth of the total area is under cultivation.

Before going more into detail as to the leading crops raised, we wish to give a few facts relative to the soils of the island. For this information we are indebted to Mr. Frank D. Gardner, Special Agent in charge of the U. S. Agricultural Experiment Station at Mayagüez.

Around the coast is a narrow fringe of coral sand, varying in width from a few rods to a mile, and consisting of level stretches or sand-dunes, and having a flora very different from that of the mountains. There are but few species. This strip is valuable only for raising cocoanuts and pineapples.

Between the coral sand and the mountains is a level tract of land, known as the *playa*, and varying in width from the fraction of a mile to several miles. The texture of this soil varies from sand to clay loam, and it is alluvial in character, having been brought down from the mountainous interior. This, the most fertile part of the island, is devoted to the growing of cane and to grazing purposes. There are, perhaps, as much as 200,000 acres of this land. It has been planted in canes for many years, and is much impoverished in many places; but in times of flood, as during the hurricane of 1899, it is enriched by the overflow from the mountains, bringing down silt and fine sand or organic matter.

We may divide the remaining portion of the island into the foothills and the mountains proper. The former, along the north side, as well as some of the mountains, are largely of coral limestone, and give rise to soils that vary in colour from black to red, the dark colour being due to organic matter and the red to iron compounds. These soils are shallow, except in the bottom of ravines and sinkholes, which are common. The hillsides are often very steep. Crevices are numerous and deep, and, when filled with soil, furnish good opportunities for the growth of plants. The rougher hills are too stony to be of much agricultural value, but those that are more nearly covered with soil make excellent grass lands. When well drained these lands are suited to the growth of citrus fruits. Most of the higher mountains in the interior and toward the south are covered with a deep layer of soil, which is adapted principally to the cultivation of coffee, citrus fruits, and minor crops.

The fertility of these lands varies greatly according to texture, exposure, and length of time in cultivation. Where sandy in character, when put under cultivation it rapidly loses its fertility by the leaching of heavy rains, and the farmers of the interior who

grow minor crops change fields every few years. The clayey soils are not so readily impoverished by the rains.

So much, then, for the soils. We will now take up some of the leading crops.

(1) *Coffee.*—Prior to the great hurricane of August, 1899, this crop was by far the most valuable on the island, and at present it bids fair to assume the first place again in the near future. Up to 1899 about 180,000 acres were devoted to this crop, and the normal yield was 26,380 tons of marketable coffee. This yield was reduced to 6,700 tons in 1899 by the hurricane; but the plantations have so far recovered that the estimated acreage of the present (1902) crop is 166,000 acres, with a good prospect of a yield of 24,230 tons. It is confidently believed that the yield will soon reach the normal of former years, and perhaps surpass it, as the old plantations are being rapidly restored and some new ones being put out. With favourable markets and a fuller knowledge of the merits of Porto Rican coffee, this crop will, beyond all question, be the greatest crop of the island.

The best coffee is grown on the hills and low mountains, as the plant there finds a suitable soil and the requisite protection from sun, rain, and winds, being associated with larger trees. The coffee soils vary in composition, but the best seems to have a very fine clay ingredient, and, when wet, is as slippery as soap. The yield, of course, varies according to soil and cultivation; but, taking into account these varying conditions, a yield of 10 to 14 quintals per hectare is perhaps a fair average.

(2) *Sugar.*—This is also an industry of great import to the island; in fact, many believe it to surpass the coffee industry in its present importance and future possibilities. In 1900 there were about 82,678 acres planted in cane; and in 1901 the acreage was about 91,000 acres. The crop harvested in 1900 was 65,500 tons of sugar; and in 1901 it amounted to 95,850 tons. It is estimated that the present crop will reach 105,000 tons, or very little short of that of 1884, which was the largest crop ever grown on the island, reaching the sum of 108,000 tons. With the establishment of large factories and an increased acreage, there is every prospect of doubling the yield of sugar in a very few years.

(3) *Tobacco.*—The tobacco crop is rapidly assuming an important place. The acreage has been largely increased within the last year, and the indications are that the present crop (1902) will surpass that of any former year, notwithstanding the fact that seeds

were scarce at sowing time and subsequently unfavourable weather militated against the crop. Planters confidently predict that in a few years the island will be famed for this product alone. Effort is being made to introduce the best varieties and employ the most improved methods in the cultivation and handling of the crop. The chief varieties now cultivated are Guacharo, Virginia blanca, Corazon de Vaca, and Cubarro.

(4) *Fruits.*—Hitherto pomology has been practically an unknown art in Porto Rico. Nevertheless, the fruits of the island have been and are of very great economic value to the inhabitants, and may become a source of no small income. This subject is so large as to demand a separate discussion, and can only be touched upon here. The value of the export of fruits has now reached the sum of $100,000 per year. There are many tropical fruits, such as the guava, that are too perishable for transportation to northern markets except in some manufactured form.

There are several varieties of the orange in Porto Rico, some of which are of an excellent flavour, and this, too, although very little effort has been made to improve the quality. Heretofore the yield of such trees as grew spontaneously on the wild lands has been sufficient to satisfy local demand, and little or no effort has been made to extend or improve the crop.

The banana grows rapidly and bears abundantly, but the lack of a market has limited the production to supplying home consumption. Several varieties are met with, such as the *musa sapientum*, *musa chinensis*, *musa paradisiaca*, and *heliconia Bihai* (wild plantain), and, as a rule, the flavour is unsurpassed.

The cocoanut abounds, but is not very suitable for shipment to northern markets, as it contains too much "milk" and not enough "meat." A better variety might be introduced, and would doubtless give satisfactory returns.

There are other minor fruit crops, such as pineapples, lemons, limes, guava, alligator pears, and so on, cultivated only in so far as the needs of the local markets require.

2. Stockraising.—This has long been an important and remunerative industry. Cattle, horses, mules, sheep, goats, and hogs are raised not only for local use but for export as well. In 1897 there were in the island about 303,612 head of cattle, valued at six million pesos; 67,751 horses, valued at two million pesos; 4,467 mules, worth about 134,000 pesos; and other live stock, aggregating in

value about 100,000 pesos more. Thousands of acres of land are devoted to pastures, and the pasturage is good the year round.

3. MANUFACTURING.—Porto Rico has, of course, a number of sugar factories, one or two of which are new in every respect. Cigars, cigarettes, and straw hats are made, and there are three or four match factories, two or three soap and vermicelli factories, a number of distilleries, several ice plants, six foundries, a sash and door factory, and several bottling (soda water) establishments.

4. MINING —There are some eighty mining concessions in the island; but these are not in operation, excepting one or two gold placers and some salt works. The gold placers at Corozal have been worked, but the yield scarcely justifies the expense. Deposits of iron ore of the first quality are practically inexhaustible, and are found at many places on the island, but the deposits known as "Iron Hill," near the east coast, and those near Arroyo, are famously rich. Many other minerals, such as copper, galena, jet, lignite, pyrolusite, electrum, bismuth, nickel, and quicksilver have been found, but not in paying quantities.

TRANS-CONTINENTAL RAILROADS IN AUSTRALIA.

No railroad lines have yet been extended across the continent of Australia. In view of the recent union of the five colonies as States of the Commonwealth and of the growing importance of West Australia, with its vast resources in gold, the necessity for closer communications between all parts of the continent is being impressed upon the people by their leading men. Plans have been formulated for three trans-continental railroad lines, and, according to the Australian press, one or all of them will soon be carried out. The accompanying map shows the routes of the proposed railroads. It is expected that the route to be extended across the southern part of the continent will first be built.

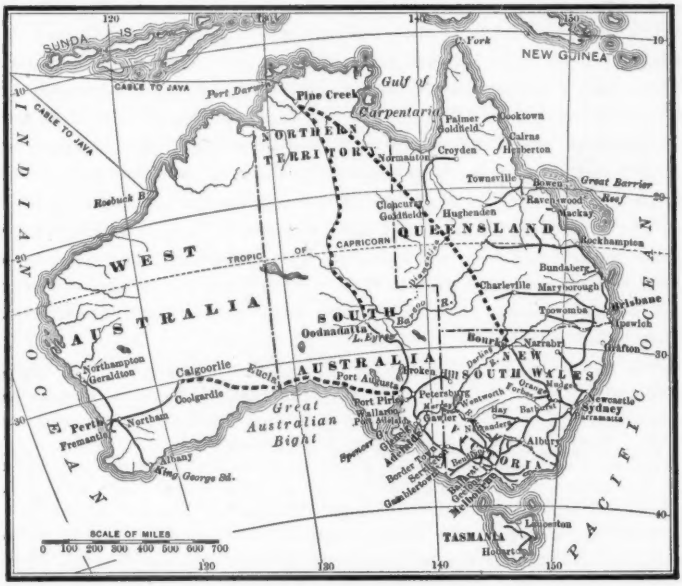
Sir John Forrest, the first Minister of Defence of the Commonwealth, is the author of the project to extend the southern system of railroads across the south part of the continent connecting Sydney on the east and Fremantle on the west coast. Port Augusta, in South Australia, the outlet for the pastoral regions west and the wheat lands northwest of it, is now the western terminus of the South Australian railroads. A line—1,068 miles in length—is to be built along the coast on the southern edge of the Great Victoria desert to Eucla, a little fort on the frontier between West Australia and South Australia, and thence northwest to the well-known gold mining centre of Calgoorlie, which already has a railroad connecting it with Perth, the capital of West Australia, and the port of Fremantle. This line along the level coast may be quite cheaply constructed, the cost being estimated at something over $10,000,000.

A railroad is in operation between Adelaide, Port Augusta, and the town of Oodnadatta, South Australia. The best harbour on the north coast is Port Darwin, the outlet for neighbouring gold and tin mines and the landing-place of two of the cables that connect Europe with Australia. A railroad from Port Darwin, 145 miles long, extends to Pine Creek, in the heart of the mining region. Pine Creek and Oodnadatta are to be the terminal points of the north and south railroad across the heart of Australia. Adelaide, on the south coast, will thus be connected with Port Darwin by a continuous rail route 1,896 miles in length.

Plans have also been made for another north and south trans-continental road to the east of the route just mentioned. The town of Bourke is now the terminus in the northwest of the railroad system of New South Wales. The proposed road is to be built in a comparatively straight line between Bourke and Pine Creek. It will

be 1,600 miles long, and its completion will link Sydney with Port Darwin by a continuous railroad 2,247 miles in length.

The first of these north and south railroads will be the shorter one, but it will have the disadvantage of passing through the uninhabited and worthless desert of Central Australia. The longer route between Sydney and Port Darwin will have the advantage of passing, in its southern portion, through a great region of grazing lands, whose utility may be largely enhanced by the development of artesian wells. It may also be easily reached from the east coast ports by the extension of the present Queensland lines, which are shown on the map.



EXISTING AND PROPOSED RAILROADS IN AUSTRALIA.

The trans-continental connections with Port Darwin are expected to have a great effect upon the fortunes of that port, which now merely serves the needs of a few thousand miners in the most isolated part of the continent. It is probable that after Sydney, Melbourne, and Adelaide are thus connected by rail with Port Darwin, that town will become the terminal port in Australia of a steamship line plying to Port Arthur, China, where freight may be transferred to and from, through European trains, by way of the Manchurian and Siberian railroads, thus greatly shortening the time between Australia and the ports of northwest Europe.

LIFE AMID DESERT CONDITIONS.

BY

RICHARD E. DODGE.

The influence of desert conditions upon the habits and customs of peoples, and on the spirit and life of nations, has been strong and abiding throughout all time. The life is nomadic, the government patriarchal, the dependence on the flocks and herds absolute, as a pastoral life is the natural life amid such climatic conditions. Aridity or semi-aridity favours a pastoral, nomadic life all over the world, except in the regions about the poles. On the other hand, moisture favours agriculture and a more settled form of government, far different habits of life, and naturally, therefore, far different thoughts and inspirations. People cannot transplant themselves from aridity to humidity, or from humidity to aridity, without great hardships and difficulty in adapting themselves to the new conditions.

The great problem of the arid western United States, that of water rights, has been complicated by the fact that the region has been settled from the humid East, which introduced the common law understanding of water rights that was brought to America from moist England.*

The explorers and pioneers had no appreciation of the problems now vexing those who followed in their footsteps. They came from a race and communities that knew no need of moisture beyond that which fell from the clouds, and had no knowledge of irrigation except such as they might have absorbed from references to this ancient art in their Bibles. The first generation of homemakers among the plateaus and deserts were not much wiser than the explorers, the trappers, and the missionaries who had preceded them. Farms were few and far between, and the water required for their irrigation was cheaply diverted from the stream and applied to the soil with a prodigality which took no account of the future. Under these circumstances it is not strange that as the wilderness was carved into territories, and as the territories blossomed into states, these new communities applied the English common law to conditions it was never intended to fit. Had the Napoleonic or Spanish Code been chosen there would be a far different story to tell, for these were framed with an intelligent appreciation of the value of water for irrigation; but the western pioneers carried to their new homes English traditions as well as English speech, and planted English law and custom at the foundation of their institutions. This beginning was fraught with peril and frequently with far-reaching evil.

In viewing such a problem as the one before us, it is well to remember that no hard-and-fast lines can be drawn between deserts

*Wm. E. Smythe, The Struggle for Water in the West (*Atlantic Monthly*, Vol. LXXXVI, November, 1900, pp. 646–654).

and non-deserts. Bordering a desert where the rainfall is less than ten inches a year there is naturally a region where the actual amount may vary within a considerable range. Any region where the rainfall is, on the average, between ten and twenty inches a year is a grass or steppe region, or, as we might say, a semi-arid region. In the rainy season the vegetation vies in its luxuriance and beauty with that of the more humid areas; but in the dry season all is changed, and the area may present a truly desert-like appearance. In steppe lands as well as desert lands the great article of value is water, and every act of life is directly or indirectly dependent on the presence of water.

The general conception of a desert, held consciously or unconsciously by most people, is that it is a great tract of seemingly boundless plain, over which the blinding sand is constantly blowing with a severity that makes heroes of those who brave its attacks. The only variations in the monotonous uniformity of the landscape are supposed to be the gentle swells of the omnipresent dunes of sand, continually growing and marching in the direction of the prevailing wind. The climate is supposed to be extremely hot and enervating, and so severe that few forms of life can secure a permanent home. In fact, the oases are believed to be the only pleasant spots in an almost impossible land, beautiful in their colour effects, in striking contrast to their surroundings, which are supposed to be white. We think of oases as actually and relatively among the most beautiful spots in the world, veritable Gardens of Eden, with all that the name implies. It is held that a desert is a region to be avoided, to be crossed only under the direst necessity, and then as expeditiously as possible.

There are such regions, but they are few, and most deserts differ from the common conception. Sand is conspicuous by its comparative absence in a desert, and when found it is but rarely white and dazzling. One of the best short-hand descriptions of a desert is that of the desert-lover Charles F. Lummis, who says it consists of "sun, silence, and adobe." The adobe, which is fine soil of great potential richness, covering deeply nearly all the lowland and gentle slopes, is far more common than sand.

The desert may be divided into three kinds of surface—the stony surface, from which the loosened waste has been removed; the sandy areas, made of the coarsest waste; and the adobe lands, made of the finer rock particles. Even in the Sahara, our greatest desert, the sand areas are estimated as not to exceed a third of the surface.

The topography of a desert is very truly one of gentle slopes, but nearly all deserts contain striking contrasts of relief. In the Sahara, which has a mean altitude of 1,407–2,100 feet, there are mountain ranges over 7,000 feet in height; and in New Mexico and Arizona there are similar ranges or peaks rising 3,000–5,000 feet above the general level of the desert. Thus the relief of a desert is varied, and the landscape is anything but monotonous. In fact, there is a striking variety of forms in a given space.

Similarly, the climate of a desert is misunderstood. It is a region of great warmth in the middle of the day; but it is also extremely cold at night—a fact of great importance, for it means that one's blood is not continually overheated in a long, unbroken warm spell, such as are known on lee coasts in the regions of the prevailing westerly winds. The daily range of temperature may be as great, if not greater, than the annual range in some so-called more favourable regions. In Arizona and New Mexico a diurnal range of 60° F. is not uncommon; and in the Sahara a range of 130° in a single day has been noted. In the clear atmosphere of a desert region, therefore, the sun's rays are very penetrating, and thick sun-proof clothes are necessary. Those who wear thin clothes are severely sunburnt. The power of the sun in a dry climate is clearly described by Pumpelly.*

> I doubt whether any one who has not wintered on the plains in the interior of a northern continent can appreciate the feelings which led the early inhabitants of Central Asia to love and worship the sun. In the intense cold of an elevated region, the plains of which, unprotected by forests, are open to the almost perpetual blast of the polar wind, life would be unbearable without the quickening influence of an unclouded sun. The atmosphere of Central Asia is intensely dry; thus, especially in winter, the sun rises, runs through its daily course, and sets, an unobstructed orb, whose rays, suffering a diminution of refraction, arrive at the surface with a greater degree of warmth than would obtain in more moist regions in the same latitude. How often have I felt then that, had I been born a nomad, I should have fallen down to worship the great light-giving god of day as he was adored by the earliest bards of our race, the authors of the Vedas.

The same respect for the power of the sun is shown by the habit of cattlemen and teamers in Arizona and New Mexico, who rise before the sun reaches them. They truly say that to sleep beyond the time when the sun reaches you is to have your "eyes burned."

The animal and plant life of a desert is varied and numerous, but different from that known in a moist climate. The floral life is comparatively abundant, except in the most extreme instances of dryness, and, in many places of our southwest, the well-known sage

* *Across America and Asia*, p. 376 *et seq.*

brush, or the grease wood, practically covers the ground. Besides the shrubs there are many flowering plants; and in New Mexico there is an abundance of grass land. Even where there would seem to be no possibility of grass one can often see, in forty-eight hours after a short-lived rain, the faint green fuzz of reviving vegetation. As regards animals, the Jack rabbit, the coyote, the prairie dog, the cottontail, and the rattlesnake, to say nothing of owls, ravens, and buzzards, are numerous in our own southwest. A prairie dog village is a sign to the traveller that he is getting "out West," and a Jack rabbit proves it. With the lowlier there are the higher forms of life. The desert and the steppes abound with sheep, goats, horses, and cattle, which are not, however, indigenous in our own country; and these form the chief dependence of a large and increasing population. The Sahara, with its 3,500,000 square miles, has an estimated population of 1,400,000, and an annual export trade of several million dollars.

Such are the contrasts between the actual and the supposed conditions in an arid area. A tourist, looking out across the expanse of the "manless land" from the comfort of a Pullman car, is impressed with its awful desolation and supposed ugliness. A person with a certain love for barbaric life, and who has the delightful ability of getting in touch with his human and physical environment, has a different feeling in his contact with the desert. To him the environment is most sublime and awe-inspiring, and he marvels not at the poetry and the philosophy and the noble thoughts that have arisen amid similar conditions in the Holy Land.

To one who approaches the desert for the first time, and in a sympathetic mood, the impression is one of vastness and freedom. The inviting curves of the plains suggest an unlimited expanse beyond, and the curious perspectives give ideas of vastly-extended distance and size. The mind is at ease, in the calm and serenity of the unbounded space. With the oncoming of night, with its clear, cool, bracing air, like that of a New England October day, and later with its brilliant stars or moonshine, the feeling of wonder and reverence is deepened. No matter how long one remains in the desert the beauty of the nights never ceases to be a marvel. To see the stars shining clearly and steadily every night, as they do occasionally on a very cold winter's night in moist regions, is a revelation that never ceases to be impressive.

The sunshine, like the nights, is impressive; but the excessive strength of the sun's rays frequently makes it hard for the novice to be impressed by other things about him, at least in the heat of

the day. If one can, however, get into the shadow, he marvels at the contrast, and glories in the comfort. Shadows in a dry region are strikingly in contrast with the sunshine in temperature. One cannot feel the heat creeping in and evidently seeking a victim, as under a New England apple tree, for shadows are cool and invigorating. They give the same comfort as the night, and one who has travelled, even a little, in the desert, comes to appreciate the value of the "shadow of a great rock in a weary land."

The silence of the desert, one of the three essentials of a true desert, according to Lummis, is wonderful in its impressiveness. George Adam Smith has well said, "No one can know how many voices a tree has until he comes up to it out of the silence of a desert." Curiously enough, however, the silence is not depressing. On the contrary, it is comforting, and it breeds no feeling of lonesomeness. To lie at night on the plains, under the clear, beautiful sky, with the knowledge that you are absolutely alone, even when the silence is broken by the howl of a coyote, does not give any sense of loneliness. One can easily be less alone amid such surroundings than in the throng and rush of a city, with its harsh noises, where one expects some sympathetic touch with his fellows.

The impressive beauty of the colours, also, of a desert landscape cannot be adequately described. The absence of dark green is soon not noticed, for the greys, reds, browns, and yellows are so quiet, so soothing, so varying in their intensity, and so thoroughly mingled that their quality cannot but be constantly in mind. To see the grand colours of a deep brown cliff brought out in a clear moonlight is to see one of the most wonderful effects. In the desert tints, as in the green of the humid country, the value of shadows in bringing out the quality and the contrast is not to be overlooked. In fact, after we become accustomed to the desert range of colours, the green of an oasis comes with a shock, like a misplaced touch in a beautiful picture.

Our reverence for oases is largely due to the bodily comfort they suggest. To pass from absolute want to an abundance of water is a delight, and to have added to the water all the food that a rich garden in a warm climate can produce is more than a delight, at least by contrast with the desert. But the pleasure has its limit, and we pass gladly on to the desert again.

One more contrast between humidity and aridity that makes a deep impression upon the visitor to the desert is the absence of odour, good or bad. Going into the desert one does not notice at first the loss of odours to which he has been accustomed in the humid

regions, but when we return to a damp climate after several weeks or months in an arid region the omnipresence of unpleasant odours is almost nauseating. It is then, perhaps for the first time, that we really appreciate the beautiful purity of the atmospheric conditions of the desert.

Such are some of the effects of the desert on the thoughts and feelings of a stranger. If he comes to stay amid desert conditions he will soon find that he is living the same life as the old inhabitants, and that the desert produces certain very permanent effects upon life conditions.

We have already seen how desert conditions tend to promote nomadic life. Nomadic life being dependent on the value of the flocks, the whole existence of the nomads is a direct result of the environment. Herbertson * has summarized this as follows:

> To tend thousands of head of cattle, and to water and milk the flocks, many persons are needed. The larger the household, the more numerous the sons and daughters and servants, the more can the flocks and herds of a family be increased. So from Biblical times onward we find that the head of a family, when sufficiently rich, is the husband of more than one wife, the father of many children, the master of many servants, many of them connected with him by blood. For the same reason the grown-up sons, when married, still remain by the father, and thus a large group grows up, all related by blood. In such a society great pride of descent is felt, and long pedigrees are carefully remembered. The head of the family is absolute; his word is law.

The individual traits of the nomads are also in certain ways the direct result of the environment. From the earliest history of this country great stress has been laid upon the keenness of vision of the Indians living on the great plains. As a matter of fact, the savage of the plains has no better sight than his civilized brother, as has been clearly proved by the studies of Hudson.† He has simply learned by long training and, perhaps, hard experience the ability to interpret truly the objects in his vision. Amid strange conditions he is more helpless than his book-trained, civilized brother. In those things that mean protection and safety the savage is, however, very keen and trained. A dust to an Indian is not merely a dust, for there may be an enemy beneath it. The Indian, therefore, has learned to tell the dust raised in a dust-storm from that raised by horses or sheep. If the dust is formed by equestrians, the Indians know it from a far distance, and, further, can tell whether the rider is an Indian or a white man, and whether he is alone or in a party. His sight, however, is just as

* *Man and His Work*, p. 25.

† *Idle Days in Patagonia*, pp. 164–184.

possibly defective from weakness or age as that of a white man, and just as easily remedied.

Nomadic life amid such surroundings has a deep effect on the imagination even of primitive peoples who come to give reference to those immediate or remote causes around that produce comfort or discomfort. The Indian who pays homage or reverence to the wild beasts is trying to appease the wrath of the cause of much evil with which he is very well acquainted through long experience.

George Adam Smith, in his remarkable study of the Holy Land and the effects of the environment on the thought of the people, considers that the scenery and climate of the Holy Land were largely accountable for the rise of the Christian religion, and he shows how the spirit of the landscape is breathed through the poetic language of the Scriptures.

* The little details . . . . are, of course, not so frequent with the prophets as the long lines of the land, and its greater natural phenomena.

> *He that sitteth on the circle of the earth,*
> *And the inhabitants thereof are as grasshoppers;*
> *That stretcheth the heavens as a curtain,*
> *And spreadeth them out as a tent to dwell in:*
> (Isaiah xl., 22.)

Men who looked at life under that lofty imagination did not notice closely the details of their country's scenery. What infected them was the sense of space and distance, the stupendous contrasts of desert and fertility, the hard, straight coast with the sea breaking into foam, the swift sunrise, the thunderstorms sweeping the length of the land, and the earthquakes. For these were symbols of the great prophetic themes, the abiding justice and mercy of God, the steadfastness of His providence, the nearness of His judgments to life, which lies between His judgments as the land between the Desert and the *Great Deep;* His power to bring up life upon His people as spring rushes up on the wilderness; His awful last judgment, like *morning scattered on the mountains*, when the dawn is crushed upon the land between the hills and the heavy clouds, and the lurid light is spilt like the wine-press of the wrath of God. And if those great outlines are touched here and there with flowers, or a mist, or a bird's nest, or a passing thistledown, or a bit of meadow, or a quiet pool, or an olive-tree in the sunshine, it is to illustrate human beauty, which comes upon the earth as fair as her wild-flowers, and as quickly passeth away, which is like a vapour which appeareth for a moment on the hillside and then vanisheth; or it is to symbolize God's provision of peace to His people in corners and nooks of this fiercely-swept life of ours:

> *He maketh me to lie down in green pastures;*
> *He leadeth me beside the still waters.*
> (Psalm xxiii., 2.)

> *They looked unto him, and were lightened;*
> (Psalm xxxiv., 5, Massoretic text.)

where the effect is of liquid light, when the sun breaks through the clouds, rippling across a wood or a troubled piece of water.

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* George Adam Smith, *Historical Geography of the Holy Land*, p. 97.

But I am like a green olive-tree in the house of God.
(Psalm lii., 8.)

I will be as the dew unto Israel:
He shall blossom as the lily, and strike forth his roots like Lebanon:
His branches shall spread,
His beauty shall be as the olive-tree, and his smell as Lebanon.
(Hosea, xiv., 5, 6.)

Bring up man and the animals on the scene, and you see those landscapes described by Old Testament writers exactly as you will see them to-day—the valleys covered with corn, the pastures above clothed with flocks, shepherds and husbandmen calling to each other through the morning air, the narrow high-banked hillroads brimming with sheep, the long and stately camel trains, the herds of wild cattle—*bulls of Bashan have compassed me about.* You see the villages by day, with the children coming forth to meet the traveller (2 Kings vi.; Mark x., 13); the villages by night, without a light, when you stumble on them in the darkness, and all the dogs begin barking,—*at evening they return and make a noise like a dog, and go round about the city.* You see night,

Wherein all the beasts of the forest do creep forth,
The sun ariseth, they shrink together,
And lay them down in their dens.
Man goeth forth unto his work,
And to his labour till the evening.

You see those details which are so characteristic of every Eastern landscape, the chaff and rolling thorns blown before the wind, the dirt cast out on the streets; the broken vessel by the well; the forsaken house; the dusty grave.

* * * * * * *

By numerous little tokens, we feel that this is scenery described by Highlanders: by men who, for the most part, looked down upon their prospects and painted their scenes from above. Their usual word for valley is *depth*—something below them; for terror and destruction some of their commonest names mean originally *abyss.* God's unfathomable judgments are *depths*, for the narrow platform of their life fell eastward to an invisible depth; their figure for salvation and freedom is a *wide* or a *large place.* Their stage slopes away from them, every apparition on it is described as *coming up.* And there is that singular sense, which I do not think appears in any other literature, but which pervades the Old Testament, of seeing mountain-tops from above. *Israel treadeth upon his high places*, as if mountain-tops were a common road; and *Jehovah marcheth upon His high places*, as if it were a usual thing to see clouds below, and yet on the tops of hills. Joel looks from his high station eastward over the tops of the mountains that sink to the Dead Sea, and speaks of *morn above the mountains* broken and *scattered upon them* by the heavy thunder-clouds.

The influence of aridity upon the daily habits and occupations of people is seen in many small and large ways; and it is a surprise to find how quickly the newcomer gets accustomed to the conditions and takes them for granted. To find soda crackers kept in open boxes, and yet to have them always crisp; to have salt dry without any cornstarch as an absorbent is a universal comfort, in the summer months. The manner of preserving meat by sun-drying

or "jerking" is also a natural outgrowth of aridity, just as pickling or smoking is a natural method of preservation of meats in a humid country. Broadly considered, deserts determine a certain uniformity of action and life in many varied ways, as may, perhaps, best be seen in the manner of travel, in the form of homes adopted, and in the raiment that has been found the best suited to comfort.

All travelling is by animal, we have already seen; but it is far different from the travel of a humid region. Roads are few, and the single horseman or the group of riders usually follow trails, and always the trails lead by water-holes or pockets, so that a map of Arizona, for instance, will show you the leading trails and watering-places. It should be remembered, however, that not every watering-place is an oasis. Trailing requires an observing mind, keen to interpret small things; but yet one follows a faint trail for long distances with much more comfort and surety than one follows a more complicated series of routes in the eastern United States.

The success of trail-following seems to depend on the climate as well as on the topography of the region. An Indian or a trained white will take a sight on a gap fifty or sixty miles away and, perhaps, make his own trail for it with perfect confidence. The clearness of the air makes the details clear; the absence of fogs assures a constant vision of the object desired, unless temporarily obscured by intervening hills. The attitude of the rocks seems to be an important causal factor in trailing. In a region of folded rocks, or of horizontal rocks, deeply and maturely dissected, the topography is varied and written largely in sloping profiles. Hence, a change in perspective may make an apparent change in form, so that any chosen peak or gap would not necessarily appear the same from slightly-altered points of view. Where, however, as in many deserts, the topography presents largely horizontal profiles, any particular peak or gap is more likely to appear the same, however viewed, and, hence, can be followed with more safety and precision.

As the people of a desert must be nomadic, rather than sedentary, their homes must be easily moved or easily duplicated. The essentials of a house are that it shall keep out the wind and the sand, the clothes being relied upon to keep out the cold. Hence, the summer brush shelters of the Navahoes, or the tepees, or wicki-ups of the Utes and other tribes, are admirably adapted for desert life. A brush shelter, that can be covered by a blanket on the sunny or windward side, offers ample summer protection, and may be kept in such orderly neatness that, humble as it is, it may vie with an old New England kitchen in appearance.

XUM

The winter timber, or stone and adobe *hogan* of the Navaho, is also a form of house easily built and very comfortable. Such a house, also, is admirably in colour sympathy with its surroundings. With its open door, always turned toward the rising sun, one may pass very near to a hogan without noticing it unless one sees the door. There is the same colour protection here as exists in the coyote, for instance, which, when quiet, is almost invisible at a distance of 200 yards.

The adobe of the desert, further, makes a very permanent sun and moisture proof building material, whether used as a cement or in brick form. The old stone houses of the cliff dwellers and ancient pueblos still retain the adobe cement after a lapse of years that no one knows. The ancient house of Santa Fé, called the oldest house in the United States, is also of adobe. The adobes are easily made and easily repaired, and they weather slowly.

In the form of adobe home, seen in New Mexico, or in Syria, we have another illustration of desert conditions. Flat roofs are the striking feature of nearly all the houses in an arid region, for they are more comfortable than sloping roofs in many ways. A steep-sloped roof is not necessary where there is little rainfall, and a flat roof does not permit a peak full of dead, hot air, such as is found in an Eastern attic or shed roof; an important matter in the heat of the day, when one naturally wants a house to be cool. Furthermore, a flat roof is of great value and popularity as a sleeping-place in all countries where a dewless night invites out-of-door sleeping. Thus, wherever possible, a flat roof has many advantages over a sloping roof.

Again, in the form of raiment adopted, the essential requisite is that it be sun and wind proof. Hence, dark clothes should be avoided, as usually they are by the Arabs, for instance. The clothes should be loose, so as to allow more non-conducting layers of air between, and so that they can be readily drawn about the head. The blanket of the plains Indian is, therefore, a very natural result of the climatic environment, and is very much more serviceable than a civilized overcoat. The blanket has the additional advantage that it is easily rolled and carried on the saddle in the heat of the day, and is at hand at nightfall or in a sudden storm. Thus a blanket, except as it is associated with squalor, is the appropriate dress for an Indian, and is a sign that invention has brought forth a form of body covering very well adapted to the environment.

Such are some of the habits and customs of desert dwellers.

When once the desert habit has been acquired it becomes a strong

habit, and one not easily removed. There is a strange and, perhaps, not wholly explainable fascination about desert life. The desire to get back to its purity and beauty is at times almost overwhelming, and it increases with each successive sojourn. There one finds many comforts and delights that cannot be found even amid the high altitudes of the moist areas of the world. The desert may tend to foster a rough form of life; but it breeds men whom one comes to honour for their manliness, their sincerity, their truth, and their vigour—men who are misrepresented in print, as a rule, and whom one must know to understand.

The same noble traits are found among some Indians as among the whites. Rough as they may be in some ways, they have an admirable manliness that is very lovable; and a sojourn among Indians shows you that the belief that the only good Indian is a dead Indian is all wrong, and the result of the action of the white man and not of the Indian. The arid West has much of value to teach the moist eastern United States, as any one who gets in touch with it soon comes to feel, perhaps with a certain degree of shame.

PHYSIOGRAPHIC NOTES.

BY

RALPH S. TARR.

THE LANSING MAN.—There has been much written recently about the discovery of human bones at Lansing, Kansas, and there have been some rather startling conclusions drawn concerning the age of these remains, Warren Upham, for example, having placed their age at 12,000 years (*American Geologist*, September, 1902, Vol. XXX, page 147). The question of the antiquity of these bones is one that requires careful study of the nature and origin of the deposit in which they are enclosed. This study has been undertaken by Professor Chamberlin in company with a number of other students of physiography and anthropology. The results of this study are presented in a recent paper by Professor Chamberlin (*Journal of Geology*, Vol. X, 1902, 745–779).

Professor Chamberlin's paper first considers certain features of river action, which he includes under the heading *Scour and Fill*, in which he points out that even in a single season the bed of a stream may be changed in depth several times. He points out that the Missouri River in this spot has recently changed its course about eight years ago, having been very near the deposit in which the bones were found. An instructive diagram illustrates this section, taken from Todd's *Bulletin United States Geological Survey*, No. 158, regarding which Chamberlin says:

> An inspection of this will show that a skeleton might have been deposited on the surface of the carboniferous rock-bottom, much as in the case of the skeleton at Lansing, on the 28th of July, 1883, and have been buried in alluvium as deeply as the Lansing skeleton by August 18th, only twenty-one days later. Without doubt within a few years it would be covered by sixty feet of alluvium through the migration of the channel of the river.

A further consideration of the nature of stream deposits follows, as a result of which it is clearly shown that, by a number of causes commonly known to be connected with river work, it would be possible to bury an object to a depth and in a position similar to that of the Lansing remains. The occurrence of these bones is then considered in detail, with photographic and other illustrations, from which one gets a very clear idea of their mode of occurrence. From his studies Chamberlin draws certain conclusions of import-

ance, the first of which is that the deposit is not in true original loess, but "in a mixture of loess-like silt, carboniferous detritus, water-laid clay and other debris." The bluffs near the deposit clearly show recent work of the river in the form of slides on their faces. Chamberlin concludes his article by a statement of what he calls *The Most Conservative and Most Probable View*, followed by five hypotheses, which he includes under the heading, *Possible but not Probable Interpretations.* The article is followed by notes from Professors Calvin and Salisbury, in which they state agreement with *the most conservative and most probable view.*

This *most conservative and most probable view* is that the human remains were buried beneath deposits brought by the streams, and were not connected in any way with the original deposit of the loess. In his statement of this view Chamberlin gives details as to how the worked-over material could have been accumulated, and concludes by the following statement:

> Under this view the burial of human remains took place either during the latest phases of the erosive process of the stage indicated or in the early phase of the building of the flood-plain. The antiquity of the burial is measured by the time occupied by the Missouri River in lowering its bottoms, two miles or more in width, somewhere from fifteen to twenty-five feet—a very respectable antiquity, but much short of the close of the glacial invasion.

Glaciation of the Erie and Ohio Basins.—An exceedingly valuable monograph has recently appeared from Leverett's pen (Monograph XLI, United States Geological Survey, 1902) under the title of Glacial Formations and Drainage Features of the Erie and Ohio Basins. It is a type of the sort of glacial geology work of which there is now a decided need—namely, a careful study of restricted areas. It is quite impossible to summarize so large a monograph here, though certain points brought out are of sufficient general importance to note. Leverett states that modification by glacial erosion in the vicinity of the glacial boundary is surprisingly slight—in fact, that neither a study by map nor in the field will make the extension of glaciation clear.

A great deal of space is devoted to a consideration of changes in drainage as the result of the glaciation of the district studied. On pages 196–200 is a brief consideration of the causes for changes in drainage. In this he points out the importance of glaciation, and especially of the effects of various advances of the ice. Under the consideration of changes of drainage Leverett takes up the question of the Genesee, reaching essentially the same conclusion which

Whitbeck reached (BULLETIN, American Geographical Society, February, 1902).

The drift border of the glacial boundary in the western portion is found to be not a single deposit. It is formed in part by the border of the Wisconsin drift, in part by the Illinoisan drift, and in part by a sheet that appears to be still older than the Illinoisan, probably belonging to the Kansan or pre-Kansan. There is evidence of periods of deglaciation, as, for example, the Sangamon soil and weathered zone, in which a black soil is found, accompanied by the decay of the pebbles and leaching of the till, the lime having usually been removed to a depth of several feet, accompanied by a nearly complete solution of the limestone pebbles. This weathered zone appeared on the drift of the Illinoisan stage. Another similar zone of soil and weathering, called the Peorian, occurred after the Iowan stage.

Much space is given to a statement of the evidence of the older drift which is found in the western portion of the district studied. The oldest Kansan and pre-Kansan drift contains pieces of red granite that have become so decayed that a single blow of the hammer will break them to pieces. It is a thin deposit on the upland, where it is usually greatly weathered from top to bottom; and in the valley deposit weathering is very pronounced for 20 feet or more. Striated stones are found in the upland drift, though the striæ are rather indistinct because of the weathering. Evidence of the great age of this drift is also supplied by erosion; it is held that the narrow strips found in protected places on the valley borders represent a former filling to that elevation.

There is also a brief chapter on loess, concerning the origin of which Leverett says:

> It is generally recognized that difficulties attend the application of any one hypothesis to the entire deposit. Probably no one questions the view that the influence of the wind has been important, and nearly all will concede that water, or, at least, imperfect drainage, has been influential. The division of opinion, therefore, is concerned with the relative importance of wind and water in the distribution of the loess.

More than half the monograph is devoted to a consideration of the episodes connected with the Wisconsin stage of glaciation, including a description of the various moraines, wash deposits, striæ, and lake stages. In this monograph is included the most complete treatment so far presented of the complex history of that part of the Great Lake region which is covered by the monograph—namely, the basins of Erie and southern Ontario. The report is freely illustrated, and contains a full bibliography. It is of great interest and import-

ance to students of glacial geology and physiography, and may be counted as one of the most important monographs so far published on the glacial geology of North America.

ROCK BASINS.—In the *Bulletin* of the Geological Society of America (Vol. XIII, 1902, 293–304) Coleman gives a description of an interesting rock basin at Helen Mine, at Michipicoten, Canada. He says that most of the rock basins of Canada are due to the removal by glaciers of preglacially-decayed materials, thus revealing irregularities in the rock surface. He does not seem to consider the glacial erosion as competent by itself to form rock basins. In this he is certainly incorrect, for there have been numerous cases of rock basins described in which glacial erosion is the only explanation. In the case of the rock basin under consideration, Coleman shows quite conclusively that the basin has been caused by preglacial decay on an outcrop of iron ore. It is an interesting addition to the series of basins of irregular rock decay already known to exist.

NOTES ON CLIMATOLOGY.

BY

ROBERT DEC. WARD.

NEW SOUTH WALES RAINFALL.—The annual volume on the rainfall of New South Wales for 1899 (*Results of Rain, River, and Evaporation Observations made in New South Wales during 1899*), recently issued, emphasizes the fact that 1899 was the fifth successive year with a deficiency of rainfall. The first year of the dry period, 1895, had a shortage of rain of 21%; 1896 of 12%; 1897 of 20%; 1898 of 20%, and 1899 of 21%. The first year of the drought followed six years with abundance of rain, and that year was one of very great losses because of the over-supply of stock that had accumulated during the preceding years of abundance. An important feature of the rainfall of 1899 was the "patchy" character of the rainfall—*i.e.*, its coming chiefly from thunderstorms, and covering very small areas. These are most unsatisfactory rains. They benefit only small fractions of the country, although some of the storms are very heavy. The six "good" years, 1889 to 1894, inclusive, had an average of 28.61 ins. of rain, and the five "bad" ones, 1895 to 1899, had an average of 20.49 ins., the rainfall of the "bad" years being 28% below that of the "good" ones.

Mr. H. C. Russell, the Government Astronomer, discusses the *Recurrence of Rain* in New South Wales in a paper recently read before the Royal Society of New South Wales. The rainfall of a number of inland stations, when plotted, shows clearly a recurrence in cycles of 19 years. The year 1895 is seen to be the first of a series of years with deficient rainfall. From 1895 to the end of 1900, 25,000,000 sheep have died of starvation, in addition to the death of all the increase during the six years, which, in good years, would have amounted to about 20,000,000 more. A diagram of the moon's declination is drawn for purposes of comparison, the extreme south position of the moon for each year being selected as a convenient way of showing the motion in declination. When all the points of the moon's declination are joined by a curve there is seen to be a close resemblance between this curve and that of the rainfall. It appears that during the southerly motion of the moon for six years there is abundance of rain. The drought begins, not wholly for want of rain, but in many cases

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because of the prevalence of strong north to northwest hot winds, which do not appear when there is plenty of rain.

Mr. Russell does not say that he has "demonstrated that the moon is an active point in the weather," but he thinks that, "seeing the rain is shown so clearly to come in times of abundance, when the moon is in certain degrees of her motion south, and when the moon begins to go north, then droughty conditions prevail for seven or eight years—a phenomenon repeated for three periods of 19 years each—it is either a marvellous coincidence or there is a law connecting the two phenomena." He himself is convinced that there is some connection between the two.

THE LAST WORD ON "HAIL-SHOOTING."—The hail-shooting campaign in southern Europe has already attracted so much interest that up to this time four Congresses have been held to discuss subjects in connection with this undertaking. These Congresses were composed chiefly of persons already strongly prejudiced in favour of hail-shooting. In order that an impartial study might be made of this matter, the Austrian Minister of Agriculture called a meeting of about seventy experts, mostly physicists from various European nations. This committee met at Graz in July last, and, by a large majority, declared that in the light of the results thus far attained, the efficacy of "hail-shooting" seems more and more doubtful. Most of the experts did not hesitate to say that any success is purely imaginary. Nevertheless, it was thought that it might be well to continue the experiments a few years longer.

METEOROLOGY OF THE EQUATOR.—Dr. Hann has lately published an important study of the meteorology of the equator, based on observations made at the Pará Museum by Dr. E. Goeldi, the director (*Sitzungsberichte Wien. Akad. Wiss., math.-naturw. Clas., CXI, Abth. IIa, May, 1902*). By reason of the paucity of meteorological observations from near the equator, the Pará data are of great interest. The observations discussed by Dr. Hann are those from August, 1895, to August, 1901. The temperatures are extraordinarily uniform. The mean diurnal range of temperature for the year is 8.8° C., and the range of the monthly mean temperatures is only 1.4° C. Dr. Hann finds that the monthly mean temperature of Pará is shown to be about 2° too high on the *Challenger* charts. The mean temperature is almost constant from May to September; the lowest temperature comes at the beginning of the year, and the highest at the end. The mean annual relative

humidity is 88%, and it is about the same throughout the year. There is a single rainy season, from January to April, and a single long, relatively dry season, from May to December, but rain falls frequently during the dry season. Rain falls almost exclusively in the afternoon and evening from thunderstorms. The annual distribution of rain is abnormal for the equator; the second rainy season, when the sun passes the zenith the second time, is lacking. The thunderstorms usually occur early in the afternoon, but they show a decided tendency to begin at a later hour as the year advances. The wind is prevailingly east and southeast during the dry season, and more northerly during the rainy season. Calms are almost twice as frequent during the latter season.

Relative Humidity in Houses in Winter.—Some observations of the relative humidity in furnace-heated houses in winter, along lines similar to those referred to in this Bulletin for October last, pages 333–334, have been made by Mr. G. A. Loveland, of the United States Weather Bureau at Lincoln, Neb. In the steam-heated office of the Weather Bureau at Lincoln, during February, 1900, the mean relative humidity was 15%, with an outside air temperature of 19.2°. In December, 1899, and January, 1900, the relative humidities were 18.6% and 21% respectively. The temperature of the room averaged slightly below 70°, and the relative humidity of the air outside averaged 76.2%.

Mr. Loveland also made some observations as to the value of evaporating pans in furnaces or registers as a means of increasing the relative humidity indoors. He found that a pan evaporating 2 quarts daily is of little or no use in moistening the air. With pans of water in four registers, in a furnace-heated house, and an average evaporation of 5.9 quarts daily, there was an increase of 2.4% in relative humidity.

Bibliography of Meteorology.—A useful working bibliography of meteorology is given in the August number (dated Nov. 10) of the *Monthly Weather Review* of the United States Weather Bureau. The list is designed for teachers and students of "elementary meteorology," as is stated in the prefatory note by the compiler, Dr. W. F. R. Phillips, in charge of the Library of the Weather Bureau. The list is, on the whole, an excellent one, but there are numerous works of older dates which it would have been well to omit. The list as it stands is too long, and too discouraging, for a teacher or student of elementary meteorology.

GEOGRAPHICAL RECORD.

AMERICA.

BIBLIOGRAPHY OF NORTH AMERICAN GEOLOGY.—The United States Geological Survey has just issued as *Bulletin* 188 a bibliography of North American Geology, Palæontology, Petrology, and Mineralogy, covering the period 1892–1900. This most useful work is a combination of the annual bibliographies compiled by Mr. Fred. Broughton Weeks, and published by the Survey during the period from 1892 to 1899, inclusive. In this volume the series is brought up to the beginning of the new century. The publication of these bibliographies will be continued annually, and every ten years they will be brought together in a form similar to the one now presented. The volume of 717 pages contains 6,548 titles, arranged alphabetically by authors' names. Under most of the titles is a brief note showing the nature of the papers. The subject-index is comprised in *Bulletin* 189, the companion volume, by means of which any title in the bibliography may easily be found. One hundred and seventy-three publications, home and foreign, were consulted in the preparation of the bibliography. Mr. Weeks is entitled to much credit for this careful and laborious compilation, which will be highly appreciated by geological workers and students.

GEOGRAPHICAL BULLETIN.—Several additions have been made to the Geographical Bulletins issued by the United States Geological Survey. *Bulletin* 190 is a Gazetteer of Texas, with an introduction on its geographic, climatic, and industrial features, illustrated by ten small maps in colours, showing the mean annual temperature and rainfall, the magnetic declination in 1900, forest areas, and density of population in the census years from 1850 to 1900, inclusive. A contoured topographic map, on a scale of 25 miles to the inch, with contour interval of 250 feet, by Mr. Robert T. Hill, gives an excellent idea of the drainage and the distribution of railroads.

No. 192 is a Gazetteer of Cuba, with a geographical description and five population maps based on the census of 1899. Two other coloured maps of special interest show the distribution of the sugar and tobacco growing areas. Under the unfortunate ruling of the Board on Geographic Names the Spanish form "Habana" is preserved in this and other Government publications for the perplexity of school children and many others who may meet it.

No. 194 is a history and discussion of the Surveys of the Northwest boundary of Texas by Mr. Marcus Baker, who concludes that until a new and trustworthy determination of the longitude has been made the boundary should be shown on the 103d meridian from the Canadian River southward, and on the meridian of 103° 2′ from the Canadian northward. Thus far 30 of the 194 *Bulletins* issued by the Geographical Survey have been in the Geographical Series.

WATER SUPPLY AND IRRIGATION PAPERS.—The latest issues of these publications of the United States Geological Survey (Nos. 57–64) include a preliminary list of deep borings in this country (No. 57, Alabama–Montana; No. 61, Nebraska–Wyoming). These many hundreds of wells and borings are all more than 400 feet in depth. Borings are particularly numerous in the oil and natural gas regions; many of the wells, active or abandoned, yield salt water. Brine wells are very numerous in the large salt-yielding States. In a considerable proportion of the artesian wells sunk for irrigation purposes the water does not rise quite to the surface. In the deepest well of South Dakota, 2,500 feet, at Rosebud Agency, the water rises only to within 600 feet of the surface. Excelsior Well, at Yankton, 493 feet deep, yields 3,000 gallons a minute, and has sufficient head to raise the water 120 feet above the surface.

No. 58 gives the results of surveys for water storage and power developed on Kings River, California. The raisin crop, whose profits in 1900 were over $2,000,000, and the other fruit, stock, and general farming interests of the Fresno district, are dependent upon this river for their existence. They are now supplied with water only from gravity canals. It is proposed to enlarge the usefulness of the Kings River by building storage reservoirs and pumping works. If all the water thus diverted from the river should be put on new areas it would mean the addition of 200,000 acres of irrigated land.

Nos. 59 and 60, by J. B. Lippincott, treat of the development and application of water in the San Bernardino valley, Cal., which furnishes many varieties of semi-tropical and other fruits for the eastern and home markets. Nos. 62 and 63, by H. A. Pressey, relate to the hydrography of the southern Appalachian mountain region, which stands out as a physiographic unit far above the surrounding country. The importance of a fuller knowledge of this region has been emphasized by the movement for Governmental acquisition of the wooded lands among the mountains, to be set apart as a forest reservation. The rivers, topography, and resources are described,

and the monograph is illustrated with many photographs and two maps.

No. 64 is a discussion by Professor E. C. Murphy, of Cornell University, of the accuracy of stream measurements as ordinarily conducted by the hydrographers of the Survey.

LABRADOR.—The *Bulletin* of the Geographical Society of Philadelphia publishes (1902, No. 4, pp. 65–212) the report of the Brown-Harvard expedition to Nachvak (about 59° N.) during the summer vacation of 1900. The report was prepared by E. B. Delabarre, Ph.D. The party, composed of six men—Dr. Delabarre of Brown University, Dr. Reginald A. Daly, Instructor in geology in Harvard University, and four Harvard undergraduates—secured for the voyage the 40-ton fishing schooner *Brave*, four men in the crew. Sixty-three days were spent on the Labrador coast, and the total cost of the expedition was only $1,200. In spite of the modest proportions and aims of the expedition, the results surpassed expectations, and showed, further, that there is a large field in Labrador for profitable researches. Long sections of the coast are not yet charted with any degree of accuracy. Ranges of the loftiest mountains on the Atlantic seaboard are still unsurveyed, and offer a new field for topographical and geological investigation. Dr. Delabarre writes:

> Even such a cursory survey as ours could greatly improve the recorded outlines of the islands and coasts in hundreds of places; and accurate work by experienced men would be of much value to the numerous vessels that frequent this coast.

A land march of about 100 miles was made between the long and narrow bays of Hebron on the south and Nachvak on the north. The Eskimos, but not white men, frequently traverse it. The walking was mostly over large heaps of stone that fill the narrow valleys and cover the mountain tops. At the extremes of the route the rock formations are of gneiss, cut by trap-dykes, the characteristic rock material of the country; in the middle section, about 30 miles, the rocks are sedimentary, mostly slate. As no fossils have yet been discovered in these deposits, their age has not been determined. The mountains on the borders of the Saglek and Nachvak fiords are very lofty, and often rise in perpendicular cliffs out of the water and the tributary valleys; along the bays, on which Hebron and Ramah are situated, the mountains rise more gradually to lesser heights.

The climax of the grand scenery of the coast is reached in the Nachvak fiord with the lofty mountains around it. Dr. Daly made

over twenty soundings in the fiord, the greatest depth being 110 fathoms. Evidences of the former glaciation of this region are abundant. Dr. Daly established the fact that the main ice-sheet did not extend higher than 2,100 feet above the sea. Below that height he found all the marks of former glacial activity.

On the north shore of the fiord is the post of the Hudson Bay Company, which carries on a flourishing trade in furs and fish with the Eskimos. There are now only about 1,000 Eskimos along the Atlantic coast; from Hopedale south most of them are of mixed blood, but north of this place they are said to be almost entirely pure-blooded.

Botanical collections were made in many localities, the Labrador current was studied, and Nachvak fiord was sounded and charted. Dr. Daly was a tireless worker in the field of geology. Among other results he found phenomena of former submergence and subsequent uplift of the coast, occurring since the glacial epoch. The complete geological results have been printed in his "Geology of the Northeast Coast of Labrador," *Bulletin* of the Museum of Comparative Zoology at Harvard College, pp. 205–270, Feb., 1902.

Tyrrell's Survey between Great Slave Lake and Hudson Bay.—The Report of J. W. Tyrrell on his survey between Great Slave Lake and Hudson Bay is published in the *Annual Report* (1901) of the Department of the Interior, Ottawa. The work, accomplished between March and December, 1900, embraced 1,729 miles of surveys, in carrying out which 4,600 miles were traversed with sleds and canoes. The survey extended between the parallels of 62° 30′ and 65° from the east end of Great Slave Lake across the Barren Grounds to the mouth of Chesterfield Inlet, Hudson Bay. A correct topographical map of the routes traversed, in twenty-two sheets on a scale of two statute miles to an inch, accompanies the Report, and is a valuable contribution to the mapping of this little-known region.

One of the most important results of the survey was the discovery of the Thelon river, which, rising to the southwest of Doobaunt lake, flows north, receiving the Hanbury river as a tributary on the left, and then flows east through a series of lakes to Chesterfield Inlet. The junction of the Thelon and Hanbury is about 150 miles east of Fort Reliance, which is at the east end of Great Slave Lake. Below the junction the Thelon has for 224 miles an approximate average width of 250 yards, with a depth of 6 feet, and a current of three miles an hour. The depth of the channel in most places

measures from 10 to 14 feet, but in a few places there are not more than three feet of water over the sand-bars. Mr. Tyrrell says that this fine river provides navigation for light-draught steamers all the way from Hudson Bay through Chesterfield Inlet to the Hanbury—550 miles—excepting, perhaps, at two rapids on the river below Baker lake, where some improvements in the channel may be necessary. The survey has practically determined the extent of navigation from Hudson Bay to the west by way of Chesterfield Inlet. The Report includes tables of latitudes, magnetic declination, distances and elevation, a complete meteorological record, and many photographs of the trading posts, plains, wooded regions, lakes, and rivers.

A Gazetteer of Argentina.—The Argentine Government has just published at Buenos Aïres the *Diccionario Demogrdfico Argentino*, which will undoubtedly be a most convenient work of reference not only for the citizens of the country but also for business men in other lands who have dealings with that Republic. It gives in tabular form the name of every city, town, and hamlet in the country, alphabetically arranged, together with the province, department, and commune in which it is situated, its population by the census of 1895, the railroads and telegraphs that serve it, if any, and the fact whether it has a post office. The Gazetteer contains about 4,500 place names.

EUROPE.

Italian Emigration.—No country is more alert than Italy in looking after the interests of its citizens who emigrate to other lands. The Government publishes at Rome the *Bollettino dell' Emigrazione*, which appears every month or two, is sold for a few cents, and is full of information of use to emigrants or relating to the condition of Italians in other lands. Nos. 10 and 11, 1902, for example, contain articles on the laws and regulations of Germany relating to immigrants into the Empire, emigrant lodging-houses in Hamburg and Bremen, the condition of Italians in the United States, and advice to those who are about to make new homes in foreign countries. Italian Consuls frequently send reports of the condition of their compatriots in other lands. It is learned from the *Bollettino* that, on account of the lack of work and low wages in Italy, many go to Germany, where labour receives 3.75 lire a day instead of 1.50 to 2 lire a day as at home. In Saxony and Thuringia some Italians lead a wandering life, selling sweetmeats on the

road or exhibiting trained animals at the fairs; many others are engaged in highway and railroad building, street paving, etc.; a small number are teachers of the Italian language, students, and wine or fruit merchants. In 1900 the Italians in Prussia numbered 22,407 (3,343 in 1895), of whom 14,599 lived in eight cities of Westphalia and the Rhine Province.

STATISTICS IN BULGARIA.—A gratifying indication of the progress of Bulgaria is afforded by the large Quarterly published by the Government in Sofia and devoted to statistics of the foreign trade, the commercial movement of the ports, and the average prices of commodities in the principal towns. The Quarterly is an excellent specimen of statistical compilation; and it is worthy of note that the explanatory text and statistical tables are printed in the Bulgarian and French languages in parallel columns—a practice to be commended in the official publications of more than local interest of all countries whose language is not widely known. In July last the average price of a horse in Sofia was 90 francs; a beef animal, 95 francs; and a kilogram (2.20 pounds) of beef, 60 centimes, or a little over 11 cents.

ASIA.

A GLIMPSE OF OLD JAPAN.—The *Transactions* of The Asiatic Society of Japan (Vol. XXX, Part 2) contains a translation by Dr. G. W. Knox, of New York, of a manuscript written in or about 1716 A. D. by Arai Hakuseki, a scholar and statesman of Japan. It was intended only for his family, and was not published until a few years ago. It gives a brief account of his family, youth, education, early struggles, and of his later labours and successes at the court of the sixth and seventh Shoguns (1709–1715). The work is valuable as giving considerable insight into Japanese life and government at that time, when the Empire had been scarcely influenced by foreign nations, excepting China and Corea. When Arai became prominent in the Government, official waste and corruption were widespread, the coinage had been repeatedly debased, taxes were excessive, and the climax was reached in a law enacted in the name of Buddha for the protection of animals. Under this law many persons were imprisoned, banished, or put to death for killing animals accidentally or otherwise; doctors were provided for dogs at the public expense. As the chief adviser of two Shoguns, Arai wielded large influence, and brought about numerous

reforms in the administration of the Government. Dr. Knox's translation is a desirable addition to our sources of information concerning Old Japan.

SURVEY OF THE BAIKAL LAKE.—The *Izvestiya* of the Imperial Russian Geographical Society (No. 2, 1902) publishes a long account by Mr. F. K. Drijenko of the survey of Lake Baikal, which was begun in 1897 at the expense of the Trans-Siberian R.R., the Ministry of Marine supplying the scientific staff. The coasts and islands were mapped on a scale of one verst to an inch, the mapping being based upon a series of stations along the shores whose longitudes had been fixed by telegraph. Soundings were made wherever they would be useful to navigation, the magnetic elements were determined, and all other material needed for a full description of the lake was collected. A navigation chart for the southern part of the lake has been published, the charts for the central and northern portions will be issued later, and a general map of the lake on a scale of 18 versts to one inch will also be produced. A number of lighthouses have been constructed at points where they will be particularly helpful to the lake shipping.

OCEANIA.

THE DATE LINE IN THE PACIFIC.—The Samoan archipelago employed the Australian or Asian calendar date until July 4th last, when it adopted the Western date. This change will be convenient for the business interests of the archipelago, now almost wholly confined to Germany and the United States, which have the Western date. It is desirable that local usage shall conform as nearly as circumstances will permit with the astronomical rule, which makes the date line follow the meridian of 180° throughout. The change in Samoa makes the coincidence of the date line with the 180th meridian complete south of the Aleutian Islands to the southern limit of human occupation, except for a slight detour to the east near New Zealand to include Chatham Island in the Australian or Eastern date. The calendar date of the islands of the Pacific is shown in the following list from the United States pilot chart of the north Atlantic ocean for September, 1899:

American date: Alaska, St. Lawrence Island, all the Aleutian Islands (Attu, the most westerly, is in longitude 173° E.), Morell Island, Phœnix Islands, Samoan Islands.

Asiatic date (one day later than the American date): Siberia, Kamchatka, Copper Island, Komandorski Island, Marshall Islands, Gilbert Islands, Ellice Islands, Fiji Islands, New Zealand, Chatham Island.

THE WESTERN ISLANDS OF THE SOCIETY GROUP.—The *Bulletin* of the Geographical Society of Neuchatel (1902–1903, Tome XIV) devotes 254 pages to an exhaustive account of the western group of the Society Islands, written by Paul Huguenin, formerly in charge of the schools at Raiatea, the largest of the seven islands. The author describes the geography of the islands, gives a chapter each to the flora, fauna, and climate, and then treats of the Tahitian branch of the Polynesian race in their various characteristics, their family and social life, their language and history. The monograph is illustrated by many excellent photographs, and a number of coloured plates, together with maps of Raiatea and Tahaa (scale 1:180,000), Bora-Bora (1:120,000), and Huahine (1:140,000). The monograph is a valuable contribution to the literature of this island group. The importance of the Society Islands in their business relations with the United States has considerably increased since the establishment in 1900 of a direct steamship service between San Francisco and Papiti, shortening the voyage to twelve days.

ECONOMIC GEOGRAPHY.

ECONOMIC MAPS OF GERMANY.—The *Vierteljahrshefte zur Statistik des Deutschen Reichs* (1902, drittes Heft, pp. 132–135) contains a number of very interesting diagrams in colours and black-and-white maps, showing various economic aspects of Germany. Diagram A shows that the area devoted to agriculture and gardening comprises nearly half the area of the Empire, and has scarcely changed since 1878; the hay lands have only slightly increased, and include one ninth of the total, while the grazing lands have largely fallen off, the area given to pasturage in 1900 being only about one half that of the hay lands; this is due to the larger areas needed for tilled lands. Nearly 28 per cent. of the total area is devoted to forest industries. The area occupied by roads in 1900 was about 2,500,000 hectares, which was considerably more than the entire surface covered by buildings and waste lands. Diagrams B and C show the acreage of the most important crops. Though the sugar beet is the largest industrial staple of the Empire, its area in 1900 was only about one twenty-fourth the acreage in rye, the largest cereal crop. Maps 1, 2, 3 and 4 show the percentage of the area in each administrative district fitted for tillage or grazing, actually used for those purposes, yielding forest products, or non-productive as waste lands, roads, and building sites.

QUICKSILVER IN TEXAS.—The *Bulletin* of the University of Texas, No. 15, is devoted to the Terlingua quicksilver deposits in Brewster Co., Texas. The paying mines thus far discovered are in a rectangular strip, 15 miles long and 4 miles wide, in about 104° W. Lon. and 29° 30′ N. Lat. Mr. B. F. Hill, assistant geologist, describes the geology and topography of the district, mercury and associated minerals, methods of mining, and the production of quicksilver in all countries. One company is now producing quicksilver, and two others are mining ore, but not treating it. The total product in 1901 was 2,932 flasks, worth on an average $45 a flask. Quicksilver deposits have been found in considerable quantity in a few places, and further development will depend largely on the success attained by the mines now in operation.

CATTLE EXPORTS FROM MADAGASCAR.—In the first six months of this year 15,900 beef cattle were exported from Madagascar to Réunion, Mauritius, and South Africa, where the cattle industry has declined, owing to the prevalence of serious diseases, in the past few years. The rapid growth of the business is shown by the fact that the exports were about five times as large as in the corresponding period of 1901. More than half of the shipments were from the port of Vohemar, on the northeast coast. It is estimated that, without impairing the home supply or the normal increase, 70,000 head may be exported in a year. Considering the present need of South Africa and these islands, they are fortunate to have so convenient a source of supply. (*Bull. Économique*, Tananarivo, 1902, No. 2.)

COMMERCIAL GEOGRAPHY IN LONDON.—In his presidential address to the Geographic Section at the Belfast meeting of the British Association, Col. Sir T. H. Holdich said that a department of economic geography was organizing at the School of Economics and Political Science, and that geography would become a compulsory subject in examinations.

GENERAL.

BIBLIOGRAPHIE GÉOGRAPHIQUE ANNUELLE OF THE ANNALES DE GÉOGRAPHIE.—The eleventh annual publication of this very useful work covers the principal geographical books and articles appearing in 1901. The volume of 320 pages contains 908 titles, under most of which are printed notes of sufficient length to give an idea of the nature and quality of the work. One hundred and one titles

relate to American geography. Several pages are devoted to brief summaries of the publications of the United States Geological Survey, the Coast and Geodetic Survey, the Agricultural Department, and other departments and bureaux of the Government whose publications relate to geography. The annual reports of the State Geological Surveys are also noticed. This publication is one of the most welcome and valuable guides to the more important contributions to geographic literature.

UTILIZING MORAINES.—Dr. Rudolf Struck has an interesting paper in the *Mitteilungen* of the Geographical Society of Lübeck (Zweite Reihe, Heft 16) on the destruction of moraines in the region around Lübeck. He shows that in many places the moraines have been torn to pieces to provide material for house and road building and other purposes.

NAVIGATION OF THE ZAMBESI.—The English vice-consul at Tete writes that the Zambesi is navigable for steamers of small tonnage from the sea to Massanangue, near the rapids of Keprabassa, more than 400 miles, during eight months of the year. The shallowness of the river, due to the great width (about four miles at Sena), renders navigation difficult in the other months. Above the rapids the river is practicable for steamers to Zumbo. Commercial societies have studied the region between the rapids and Zumbo, and opened a service of two boats there; and the African Lake Corporation will next year place a steamer on this stretch of water. Funds have been subscribed to build a narrow-gauge railroad around the rapids. When this railroad is built the Zambesi, for 600 miles, will be in steam connection with the Cape Trans-Continental Railroad, and will carry to it the commerce of a large region hitherto inaccessible.

THE POPULATION OF CHINA IN 1902.

Early in 1902 the Chinese Government began an enumeration of the population of the Empire for purposes of taxation. The results have been officially announced, and are published in the Peking *Gazette* and other Chinese newspapers. There is reason to believe that the enumeration (including some estimated areas) has been made with more than ordinary care, and that the result will be accepted as a satisfactory approximation of the population of China.

The population of the Empire by provinces and dependencies follows:

PROVINCES.	POPULATION.	PER SQUARE MILE.
Chili	20,937,000	362
Shantung	38,247,900	689
Shansi	12,200,456	183
Honan	35,316,825	576
Kiangsu	13,980,235	379
Nganhwei	23,672,314	446
Kiangsi	26,532,125	393
Chehkiang	11,580,692	333
Fukien	22,876,540	554
Hupeh	35,280,685	535
Hunan	22,169,673	298
Shensi	8,450,182	114
Kansu	10,385,376	79
Szechuen	68,724,890	427
Kwangtung	31,865,251	401
Kwangsi	5,142,330	64
Kweichau	7,650,282	131
Yünnan	12,721,574	82
DEPENDENCIES.		
Manchuria	8,500,000	23
Mongolia	2,580,000	2
Tibet	6,430,020	9
Turkestan	1,200,000	2

The population of the eighteen provinces of China proper is 407,734,330, according to this enumeration, or 301 to the square

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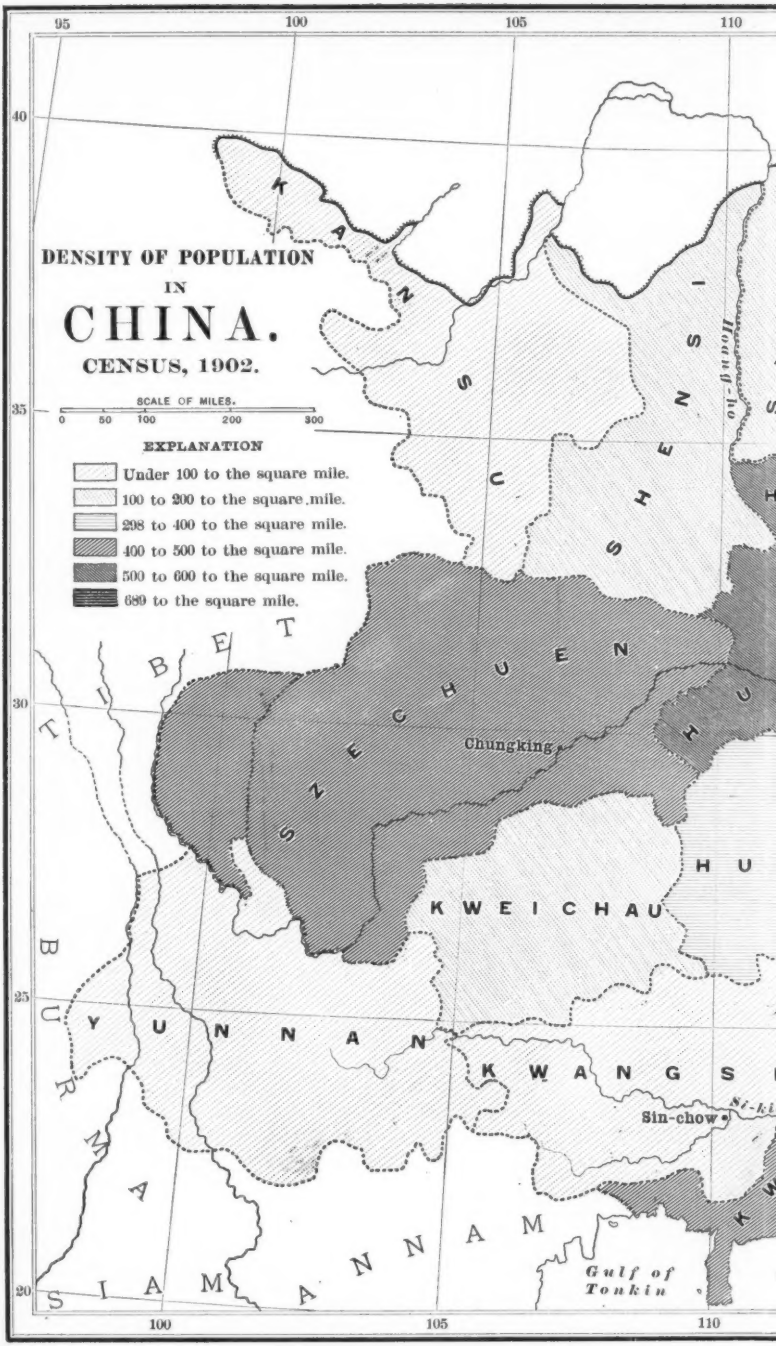
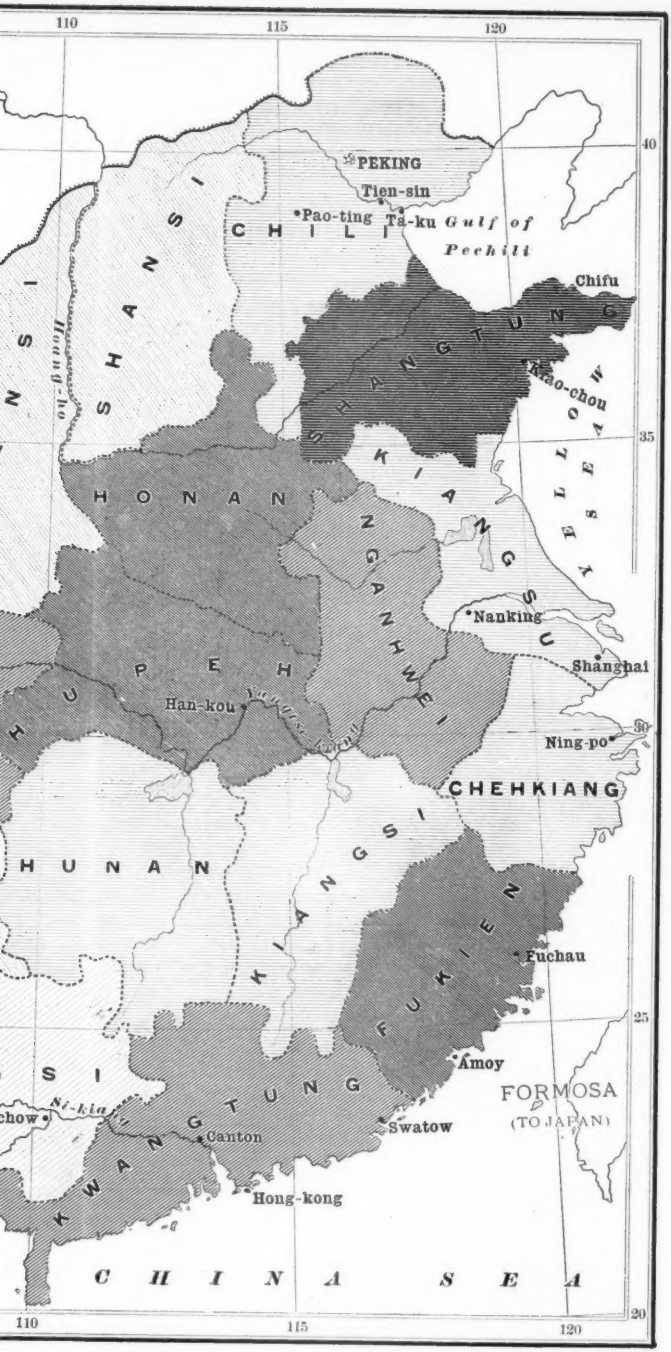

DENSITY OF POPULATION
IN
CHINA.
CENSUS, 1902.
SCALE OF MILES.
0 50 100 200 300
EXPLANATION
Under 100 to the square mile.
100 to 200 to the square mile.
298 to 400 to the square mile.
400 to 500 to the square mile.
500 to 600 to the square mile.
689 to the square mile.
95
100
105
110
40
35
30
25
20
KANSU
SHENSI
Hoang-ho
TIBET
SZECHUEN
Chungking
KWEICHAU
YUNNAN
KWANGSI
Sin-chow
BURMA
SIAM
ANNAM
Gulf of Tonkin


110
115
120
40
35
30
25
20
PEKING
Tien-sin
Pao-ting
Ta-ku
Gulf of Pechili
C H I L I
SHANSI
Hoang-ho
Chifu
SHANGTUNG
Kiao-chou
YELLOW SEA
KIANGSU
HONAN
NGANHWEI
Nanking
Shanghai
HUPEH
Han-kou
Yangtsze Kiang
Ning-po
CHEHKIANG
HUNAN
KIANGSI
FUKIEN
Fuchau
Amoy
FORMOSA
(TO JAPAN)
Si-kia
Canton
Swatow
KWANGTUNG
Hong-kong
C H I N A S E A

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mile. The population of the dependencies is 18,710,020, making the total population of the Empire 426,444,350.

The accompanying map shows clearly the density of population in China proper. It will be observed that the population is most dense in the wide basin of the Yangtse river and in some of the coast provinces, and is least dense in the mountainous regions of the northwest and southwest. The largest density is in Shantung, which contains very large agricultural and mineral resources, and includes the fertile valley of the lower Hoang-ho.

In the first six volumes of *Die Bevölkerung der Erde* the Chinese enumeration of 1842 with a total of 413,000,000 was accepted as worthy of credit. The seventh volume, however, went back to the enumeration of 1812, which gave a population of 360,000,000. The editor explained that this was done because the mass of criticism was opposed to the acceptance of the figures of 1842, and the known wasting of the population by wars and famine seemed to justify smaller figures. Some of the best writers on China have declined to express any opinion as to the population. Thus Richthofen, in his great work "China," published in 1882, simply reproduced the Chinese figures of 1812 and 1842 without comment.

In recent years, however, more credence has been given to Chinese population statistics. Mr. E. M. Köhler expressed very well the prevailing feeling when he said in a recent number of the *Deutsche Rundschau* that though the methods of the Chinese census are inexact they are more trustworthy than the estimates of foreigners, who know only a small part of the country. He gave the results of the census from 1711 to 1882, and reasons for assuming that 380,000,000, the figures of 1882, were approximately accurate at that time.

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NEW MAPS.

AMERICA.

THE UNITED STATES. Drainage Basins of the Southern Appalachian Mountains. Showing gaging stations maintained by the United States Geological Survey. Scale 22 statute miles to an inch. No. 62 of the *Water Supply and Irrigation Papers* of the United States Geological Survey.

The drainage of the Appalachian region south of West Virginia is indicated in blue, and drainage areas are outlined in red. A companion map, on the same scale, shows the topography of the region.

THE UNITED STATES. San Bernardino, Redlands, and Vicinity. Showing the Irrigated Lands. By J. B. Lippincott. Scale 1 statute mile to an inch. No. 59 of the *Water Supply and Irrigation Papers* of the United States Geological Survey.

This region, one of the great centres of our home production of semi-tropical fruits, owes its fertility entirely to irrigation. The artificially-watered areas are shown in green, and red points locate the numerous wells. Approximate hydrographic contours are given, and the surrounding mountains are also shown by contours.

CANADA. Map of the Dominion of Canada and Newfoundland. Scale 1: 217,600, or 35 statute miles to an inch. Ottawa, Department of the Interior, 1902.

The map is in eight sheets, each 25 by 26 inches, engraved on copper, and very clearly printed in 8 colours. It is the first complete recompilation of the map of Canada since the map of 1866 published by the Geological Survey, which, however, did not include that part of British North America lying north of the 53d parallel and west of the 103d meridian. It shows all the railroads, with their United States connections, township outlines, park and forest reserves, all settlements of over 1,000 population, and also smaller villages in the thinly-settled regions. The new Hudson Bay posts are included, and also the latest results of the surveys of McConnell, J. B. Tyrrell, McArthur, and Gwillim in Yukon and northern British Columbia; of J. W. Tyrrell and Dowling in Keewatin, and of Low in Ungava. The map includes 6,000 names, and the spellings may be accepted as the official Canadian nomenclature. As Canada still lacks a detailed and exact survey, it cannot yet be mapped with the closest approach to accuracy; but this careful product, on a scale large enough to show a great deal of information without overcrowding, is particularly noteworthy, and will be widely useful.

GREENLAND. Einheimische Namen an der Küste von Nordgrönland von Kap York bis Smith-Sund. Scale 1: 1,120,000, or 18.9 statute miles to an inch. By Dr. Robert Stein. *Petermanns Mitteilungen*, 1902. Tafel 18. Gotha, Justus Perthes.

The comparatively large scale of the map makes it possible to show the outline of the coastal regions with considerable detail. The Eskimo name for each of the Geographical features from Melville Bay to Smith Sound is given. An inset map on a scale of 1: 10,000,000, or 157.8 statute miles to an inch, shows the extent of lands known to the Smith Sound natives.

BERING STRAIT. Die Goldgebiete zu beiden Seiten der Bering-Strasse. By Capt. Fr. Immanuel. *Petermanns Mitteilungen*, 1902. Tafel 5. Gotha, Justus Perthes.

Four maps on one sheet: 1. Die Goldfelder von Klondike, scale 1:10,000,000, or 157 statute miles to an inch, indicating the gold fields of the Yukon basin from the sources of that river down to the Tanana; 2. Seward Halbinsel, scale 1:2,000,000, or 31.5 to an inch (it distinguishes the areas between Norton Bay and Cape Prince of Wales in which gold is being mined, which are known to be gold-bearing, and which are supposed to be gold-bearing); 3. Die Verkehrswege nach den Klondike Goldfeldern, scale 1:20,000,000, or 315.6 statute miles to an inch, showing the land and sea routes to the gold fields of Alaska and the Klondike; 4. Die Tschuktschen Halbinsel, scale 1:3,000,000, or 47.34 statute miles to an inch.

WESTERN SOUTH AMERICA. Geographische Verbreitung der hauptsächlichsten Eruptionszentren und der sie Kennzeichnenden Vulkanberge in Südamerika. Scale 1:10,000,000, or 157 statute miles to an inch. By Dr. A. Stübel. *Petermanns Mitteilungen*, 1902. Tafel 1. Gotha, Justus Perthes.

The positions of 117 active volcanoes extending from Colombia to Tierra del Fuego are indicated; those whose eruptions in the nineteenth century were particularly violent are distinguished from the others.

GUATEMALA. Die Ausbreitung des Erdbebens von Guatemala, April 18, 1902. Scale 1:1,750,000, or 27.6 statute miles to an inch. By Prof. Dr. Karl Sapper. *Petermanns Mitteilungen*, 1902. Tafel 17. Gotha, Justus Perthes.

The positions of the volcanoes and the areas in which very severe, severe and moderate, damage was done, are indicated; also the regions in which no damage was done, but where the shocks were plainly felt, including the whole of Guatemala and most of Salvador.

EUROPE.

FRANCE. Carte des Rivières navigables et des Canaux exécutés, en construction et projetés. Scale 1:1,390,000, or 21.9 statute miles to an inch. Paris, Maison Andriveau-Goujon, Henry Barrère, Editeur, 1902.

The canals being strongly shown in red and the rivers in blue, the relations between the two systems of waterways are seen at a glance. A fourth of France's domestic commerce is carried on these waterways; and this map is better adapted than any other recent publication to show how far waterways serve the commerce of every part of France and the way in which rivers and canals supplement one another.

BULGARIA. Verteilungen der jährlichen Niederschläge in Bulgarien. Scale 1:1,500,000, or 23.6 statute miles to an inch. By Dr. C. Kassner. *Petermanns Mitteilungen*. 1902. Tafel 14. Gotha, Justus Perthes.

The data from a large number of rain stations are generalized, and the precipitation is shown by colours in seven degrees.

ASIA.

WESTERN ASIA.—Chemins de Fer de l'Asie Occidentale. Scale 200 miles to an inch. *Revue de Géographie*, April, 1902. Paris.

A sketch map, showing all the completed railroads from Constantinople to India, including the recent extension of the line from Petrovsk to Baku, giving that great centre of petroleum production a through rail route to Russia; the extension of the Trans-Caspian line to Tashkent, with a branch to Andijan in Ferghana; the route of the proposed railroad from Konia in Anatolia to Bagdad and the Persian Gulf, for which Turkey has granted a concession to the Germans; and the northern part of the proposed Turkish railroad from Damascus to Medina and Mecca.

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CENTRAL ASIA.—Übersicht meiner Reisen in Zentralasien. Scale 1:7,500,000, or 117.7 statute miles to an inch. By Dr. Sven Hedin. *Petermanns Mitteilungen.* 1902. Tafel 15. Gotha, Justus Perthes.

The map shows the long routes followed by Dr. Hedin in his journeys from 1899 to 1902, and from 1894 to 1897.

ASIA MINOR.—Map of Asia Minor. Scale 1:2,500,000, or 39.45 miles to an inch. *The Geographical Journal*, Vol. XX, p. 372, 1902.

The map illustrates a paper by Professor W. M. Ramsay on "The Geographical Conditions determining History and Religion in Asia Minor." Topography is, therefore, strongly emphasized.

AFRICA.

WEST AFRICA.—Afrique Occidentale, sheets 58, 59, 67 and 68. Scale 1:500,000, or 7.8 miles to an inch. Paris, Maison Andriveau-Goujon, Henry Barrère, Editeur, 1902. Carte dressée avec la collaboration du Service Géographique des Colonies.

Four sheets, each 20 by 26 inches, of a map of West Africa, on a scale large enough to show much detail not usually indicated on African maps. These sheets give the Ivory Coast and its hinterland as far as 8° 30′ north. While large unexplored areas still appear, a great deal of detail is given, particularly on the two southern sheets, of regions that were blank on the maps five years ago. The advantage of so large a scale, even for a region only partly explored, is manifest. All routes of explorers are shown; all military posts, Custom houses, and mission stations; post offices, telegraph and telephone lines are indicated, and the relative importance of towns is shown by three sizes of type. Though topographic features are rather roughly indicated the figures of elevation of many places are printed. It will be a boon to students of African geography if the map of the whole of French West Africa is to be carried out on so large a scale and with such abundance of careful detail as these sheets present.

SOUTHERN ETHIOPIA.—A sketch map showing the journey of Mr. Oscar Neumann from Zeila through southern Ethiopia to the Upper Nile, 1900–01. Scale 1:3,000,000, or 47.34 miles to the inch. The *Geog. Jour.*, Vol. XX, No. 4, 1902.

This map shows that the water parting between the Omo river system (tributary to Lake Rudolf) and the Sobat system (tributary to the Nile) lies on the frontier of Kaffa and Gimirri, in the neighborhood of 36° E. Lon. The map also gives the results of the most detailed exploration yet made of the series of lakes between 6° and 8° N. Lat., occupying the north end of the great East African rift-valley, which extends in a southwesterly direction to the middle of German East Africa.

DR. SVEN HEDIN'S LATEST JOURNEY IN CENTRAL ASIA, 1899–1902.

The *Geographical Journal* (Sept., 1902) publishes the map which is here reproduced. It shows the regions in which Dr. Sven Hedin carried out his thorough explorations in Central Asia in 1894–97 and 1899–1902. It is printed here especially to show the regions he traversed on his second expedition of 1899–1902. Dr. Hedin wrote for the *Geographical Journal* a summary of the results of this very remarkable journey, from which the following facts are taken.

He mapped the Tarim or Yarkand River from the environs of Yarkand to its lower extremity near Lob Nor. The map covers about 100 sheets on a scale of 1:35,000, or about a half mile to an inch. Every name given to the stream was recorded, every channel was mapped, and the diverse characteristics of the country adjacent to the banks were all noted and plotted on the map. Material was thus gathered for a minutely-detailed monograph upon the course of the Tarim and the conditions which characterize this greatest river in Central Asia.

The part of the Gobi desert between the lower Tarim and the Cherchen-Daria, which had never been visited before, was crossed from Karaul to Tatran (north of Cherchen), and was found to differ in conformation from the desert of Takla-makan, explored by Dr. Hedin on his first journey. The sand, which is heaped up in dunes sometimes to a height of over 300 feet, is not continuous, but is interrupted by tracts of perfectly level soil, entirely destitute of sand. In the southern parts of the desert, where patches of tamarisk and reeds were occasionally met, water could be obtained by digging six or seven feet.

The lower course of the Tarim, between Yanghi-kull and Karakoshun, is very intricate. The country is so flat that the current is continually seeking new channels. The Chinese, who had built settlements on the river banks, were in danger of being deserted by the stream, and the inhabitants were considering the advisability of building dams to retain the water.

The tendency of the Tarim to form lateral or marginal lakes begins as high up as Yanghi-kull. Between Yanghi-kull and Arghan the right bank is accompanied by a chain of long lakes bordered by sterile sands, with sand dunes as much as 300 feet or more in height. The sand dunes turn their steep side towards the west,

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Sketch map showing
Dr SVEN HEDIN'S ROUTES
in
CENTRAL ASIA
Scale of Miles
Routes 1899 to 1902
1894 to 1897
TURKESTAN
RUSSIAN EMPIRE
INDIA
AFGHANISTAN
TIBET
Taklamakan Desert
Tarim Basin
Kuruk-tagh
Altyn-tagh
Kara-koram
Himalaya
Nan-shan
Kuen-lun
Pamirs
Karakul
Yarkand
Kashgar
Khotan
Aksu
Maralbashi
Kucha
Korla
Turfan
Hami
Lop Nor
Charchan R.
Keriya R.
Yarkand R.
Tarim R.
Indus R.
Sutlej R.
Brahmaputra R.
Ganges R.
Yangtse Kiang
Mekong R.
Salween R.
Irrawaddy R.
Shamo Desert

while on the east they mount more gradually to the summit. This arrangement is due to winds from the east.

The position of Lob Nor is now solved. The ancient historical Lob Nor is situated where Richthofen believed it had been discovered, but its basin is now dried up. On its northern shore Hedin found ruins of towns, settlements, and temples, as well as a number of manuscripts, letters of local origin, and tablets of tamarisk wood bearing Chinese script and dating from 264 to 465 A.D. He also discovered on the shore of the ancient lake unmistakable indications of a great caravan route. His precise levellings, covering the whole of the lake basin, showed conclusively that the former Lob Nor and the present Kara-koshun lie practically at the same level, and are separated only by a slight rise of ground. Kara-koshun shows a decided tendency to return to its former situation—a large lake to the north of it, a journey around which required four days.

The mountain chain of Astyn-tagh (Ustun-tagh on the map), from the meridian of Charklik to Anambar-ula, proves to be a double one, not single, as shown on our maps.

Dr. Hedin's work included three journeys into or through Tibet. His first expedition (July–October, 1900) was from Mandarlik due south as far as 33° 45′ N. Lat., thence northwest, north, and northeast to his starting-point. A large part of the caravan, including one man, perished under the incredible hardships encountered in these lofty regions. Various mountain chains were crossed, and the orographical structure of the Kwen-lun and the complicated mountain system of northern Tibet were cleared up. The positions of a large number of salt and fresh water lakes were determined; the greatest depth measured was 157½ feet. The topographical results of this journey were embodied in a map of 150 sheets.

The second expedition started from the same base. Its object was to complete the mapping of northern Tibet, especially of the mountains to the north of Kum-kull. This lake, also, was sounded. These Tibetan lakes are dangerous to navigate in a small open sailing boat.

Dr. Hedin's principal and longest journey through Tibet began at Charklik on May 17th, 1901. His route from Charklik to India is shown on the map. With two attendants, and in disguise, the explorer made a perilous journey as far as the neighbourhood of Tengri Nor, where the emissaries of the Dalai Lama compelled him to return to his caravan. A second attempt to penetrate south from the same camping-place was frustrated at Sellisy-tso by a

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force of 500 horsemen. He then went westward to Leh, the journey costing the lives of two men and almost all his animals. The results of this last journey in Tibet are recorded on the map of 370 sheets.

In this great series of explorations Dr. Hedin lifted the veil that has hidden vast stretches of the mountainous and desert regions in the heart of Asia. His cartographic material includes 1,149 sheets, controlled by 114 astronomical determinations of place, in making which he used an alt-azimuth theodolite and three chronometers. His meteorological observations were recorded without interruption; he took over 2,000 photographs, and brought home considerable collections illustrating especially geology, archæology, and the fauna. He is now engaged in writing a popular description of his work; the scientific results will be published later.

M. FROIDEVAUX'S PARIS LETTER.

PARIS, November 20, 1902.

We are still without any precise indication as to the results of the researches made during the summer so far as these relate to geography; but we begin to receive reports from travellers returned from distant regions. M. G.-B. M. Flamand has made new geological researches in the forest region of the plateaux in southern Oran. M. Edmond Doutté, whose travels in Morocco have been already noted, has continued his observations, at first in the south, then in the direction of Marakesh, where he expected to make a centre for ethnographical study, with excursions to Amsmiz, Demnah, and Rehamna.

Lieutenant Mazeran is engaged in studying the Senegal River and its freshets. Dr. Maclaud has published the maps of his journeys in Fúta Jallon, with corrections of many errors. He has just been placed at the head of the French Commission, charged with the settlement of the boundary line between French and Portuguese Guinea.

M. Fourneau has set out for the Chad, in company with M. Bruel, who finished before his departure a map of the Upper Shari, on a scale of 1:100,000, with the help of all the documents brought together by our officers. It is to be hoped that this important map will soon be published.

Lieut. Collat, of the Duchesne-Fournet party, has returned from Ethiopia, and the Du Bourg de Bozas Mission is the way to the Omo river.

In Central Asia M. D. Levat has made a study of the hydrography of the Amu Daria. He has also visited the auriferous placers of Eastern Bukhara, and examined the geology and the mineral resources of the Darvaz and the Karateghin; and he crossed the Alaï Mountains in company with M. André Petit by the still unknown pass of Karagush-Kana, 13,680 feet above the sea. This pass, by which the journey from Khokand to the Karateghin can be made in four days, is occupied by a glacier nine miles in length. Altogether, M. Levat has laid down a new route of nearly one hundred miles.

M. Lacroix, in his second visit to Martinique, established the fact that the Montagne Pelée is at present in a condition of feeble activ-

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ity. He took advantage of the opportunity offered by this state of things to ascend the mountain on the northwest side to the crater, and to determine its shape. He found the lake Des Palmistes dry and filled with ashes, as it was in the month of June, and in the very middle of the crater there was a cone without a central orifice, but with sulphurous vapours rising from its walls. The conditions within the devastated region are: Since the eruption of the 30th of August the line of devastation on the north and east coasts, starting from Morne Rouge, follows very closely the course of the River Capot, extending on its right bank and with a slight inclination eastward to the bed of the river. Thence it turns to the southern part of the Ajoupa Bouillon at about 650 feet to the south of the church, leaving the greater part of the village untouched.

Beyond the Falaise river the zone of devastation is of irregular breadth, and extends from a mile and a quarter to about two miles from the shore.

The strip along the coast is unharmed, and retains its superb verdure, only the dwellings at the mouths of the rivers having suffered from the eruption; Basse-Pointe, for instance, is buried to the roofs of the houses.

All along the coast there are great accumulations of soil; it is now possible to walk from Macouba to the Grand' Rivière, at the base of the cliffs, against which but lately the breakers rolled.

It is to be noted that, notwithstanding the reports, no crater exists at the Ajoupa-Bouillon; neither have there been great cracks opened reaching to Basse-Pointe, nor subsidences on the northern and the southwestern coasts. M. Lacroix has been enabled to determine a great extension of the ruined district towards the north, the east, and the southeast, and that the geological results of the explosion on the 30th of August were of greater moment than those caused by the previous eruptions. At the same time the greatest intensity of this latest outbreak made itself felt in the southwestern zone, already completely ravaged by the preceding eruptions, and this is also the region which has most to dread for the future. Since the 23d of October three posts of observation have been established around the Montagne Pelée: one on the west, 19 miles from Fort-de-France; one on the east, a short distance to the westward of Grande Anse, and so placed as to control La Calebasse, the crater itself, and Basse-Pointe; and the third in the peninsula of La Caravelle, at the Moulin-de-Beauséjour. Telephonic and telegraphic communication between these stations and Fort-de-France reports the slightest movement of the volcano, which main-

tains its activity in spite of its apparent repose. Within a month the cone at the centre of the crater has increased in elevation more than 350 feet, and this without any serious eruption.

Among new publications may be mentioned two Reports of International Congresses, held in Paris in 1900—that of Anthropology and Prehistoric Archæology, and that of Americanists. Of the former, Dr. René Verneau, the secretary, has printed *in extenso* or in a careful analysis all the communications made; and particularly to be noted are the paper by the regretted Thomas Wilson on The Very Great Antiquity of Man in North America, and that of M. R. Lehmann-Nitsche on The Fossil Man of the Pampean Formation. It is to be regretted that Mr. George A. Dorsey did not furnish the text of his communication on The Stone Age in North America. There is hardly a region of the world which has not furnished the subject of some paper submitted to the Congress.

The *Compte-Rendu* of the Americanist Congress contains, besides the papers on Columbus by MM. Vignaud and de la Rosa, an excellent study on the ancient inhabitants of Lake Colhue Huapi, in Patagonia, and M. Ambrosetti's succinct account of the Calchaqui civilisation, so far as this is known.

A Latin thesis, by M. Jean Brunhes, offered for the doctor's degree to the Faculté des Lettres, of the University of Paris, treats thoroughly and with admirable illustrations the subject of *Giant-Kettles*,* noted in a previous letter.

M. Ch. Rabot has written a very useful and exact Chronological Essay on the Variations of Glaciers, complementary, in a sense, of his work on the Variations in Length of Glaciers in the Arctic Regions. M. Charles Duffart, in his study of the soundings obtained by Capt. Durand for M. Hautreux, between 44° and 45° N. Lat., and at 2° W. Long., has verified the existence of submarine valleys perpendicular to the coast and having an almost absolute conformity with the land valleys of the Landes plateaux. This is a new proof of the existence of open bays on the Gascon shore during the Quaternary. M. Duffart announces that he is about to draw a bathymetric chart, on a large scale, of this submarine region. This will form, for a small portion of the coast of France, a very useful complement of M. Thoulet's series of submarine lithological charts of the French coasts.

The subject of irrigation has been treated by M. Jean Brunhes in a thesis entitled *De l'Irrigation dans la Péninsule Ibérique et dans*

* The title of this paper is: De Vorticum opera, seu quo modo et quatenus aquæ currentes per vortices circumlatæ ad terram exedendam operam navent.

l'Afrique du Nord. The geographical conditions, the methods, and the organization of irrigation have been studied by M. Brunhes on the spot in three regions—in Spain, Algeria-Tunisia, and Egypt—as well as in the recorded literature of the subject. The countries chosen offer, in the opinion of M. Brunhes, a collection of irrigated districts, large and small, so numerous as to afford material for a study of comparative geography and to show that the distribution and regulation of the water supply are facts of geography as related to man. Excellent maps and illustrations add to the value of this important work, by the side of which may be placed a book by Capt. Cauvet on the culture of the Palm-tree in Southern Algeria.

Mention must be made of M. Bernard's Bibliography, published in the *Bulletin* of the Algerian Geographical Society, and of the notes addressed to the Academy of Sciences by M. G.-B. M. Flamand on Tidikelt, especially the one concerning the hydrography of that portion of the Touat chain of oases, or archipelago, as it is called. M. Breschin writes in *La Géographie* of the Tropical African Forest, and ethnologists will find precious material in the documents brought together by MM. Clozel and Villamur under the title of Indigenous Customs of the Ivory Coast. The *Revue Coloniale* publishes the useful reports of the Franco-Portuguese Commission on the region between the Congo and the Cabinda, and MM. Georges Bruel and Casimir Maistre treat the question of the Bahr Sara, principal branch of the Shari. One of M. Marchand's companions, Lieutenant Dyé, contributes to the *Annales de Géographie* a study on the Bahr-el-Ghazal, and the work by MM. Angoulvant and Vignéras, entitled *Djibouti*, *Mer Rouge*, *Abyssinie*, may be recommended.

The geographical literature of Madagascar has been enriched by some works of the very first order, such as M. E. F. Gautier's *Madagascar: an Essay in Physical Geography.* This is in two parts—one devoted to the physical geography and geology of the island, and especially of the eastern part; the other to the languages and to the origin of the tribes. The author's conclusion is that the population of Madagascar is in the main of Indo-Melanesian origin. The book is illustrated by numerous engravings and sketches, and by two fine maps—geological and hypsometrical—the basis of future cartography in these directions.

The southern portion of these maps undergoes already some modification through the published itinerary of the route followed in 1901 by M. G. Grandidier, and the Third Part of M. G. Ferrand's

Mussulmans in Madagascar and the Comoro Islands adds a number of details to the ethnography as described by M. Gautier.

In Asia we have only a brief note of Lieut. François' journey in Kwang-Si, and the most notable report from America is the résumé of Dr. Berté's long account of the eruptions of the Montagne Pelée; though we could have wished to read the entire document, and to find in *La Géographie* a number of the fine photographs which accompanied the original paper.

In the last number of the *Bulletin de Géographie Historique et Descriptive*, M. Gabriel Marcel has restored to the geographer Jean Jolivet a map of Picardy of the sixteenth century; M. Georges Musset has sketched the career of J. B. Le Moyne de Bienville, and Mr. Fr. Pelletier has recounted a part of the story of the Lavérendrye—the daring raid which, in 1742–43, took the Chevalier and Louis-Joseph as far as the Rocky Mountains.

The identification of Madagascar with the island of Menuthias, maintained by M. A. Grandidier, is denied by M. E. F. Gautier; and it is to be regretted that M. C. Guignebert, in his thesis on the geographical work of Pierre d'Ailly, has not studied the copy of the *De Imagine Mundi* annotated by Columbus.

Two admirable bibliographies are not to be overlooked—that of the work of Petrus Apianus, by M. F. Van Ortroy; and the Geographical Bibliography for the year 1901, published by the *Annales de Géographie.*

HENRI FROIDEVAUX.

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NOTES OF EXPLORATION BY THE U. S. GEOLOGICAL SURVEY.

MOUNT MCKINLEY, ALASKA.—A reconnaissance party in Alaska, in charge of Mr. Alfred Brooks, left Seattle in May with an outfit of twenty pack horses, and landed at Tyonek, on Cook Inlet, June 1st, whence they crossed to the Tanana river and to Rampart on the Yukon, where work was closed in the late fall. The trip was so arranged as to skirt Mount McKinley and the Great Alaskan Range, with a view to determining the mineral resources of the region, and also of depicting the topography of this unknown area of central Alaska.

From Tyonek the party made its way north to the Skwentna and Keechatno rivers, both of which were crossed by swimming, and then took a westerly course to the Great Alaskan Range of mountains. This was crossed by an old Indian trail which led to a comparatively easy pass, and by far the best yet found; it took the party to an altitude of 4,000 feet, and is described by Mr. Brooks as the only feasible one for pack animals. Thence the party crossed one of the forks of the Kuskokwim river, which was followed for 100 miles before they emerged from the mountains. Their route took them along the northwestern base of the mountains, and they camped at one place within ten miles of the summit of Mount McKinley.

Throughout, a careful route map was made of the territory traversed and of all within sight, and, as a result, all of the western and northern side of the Great Mountain Range was mapped to its summit, as seen from adjacent foothills, with the aid of vertical angles and micrometric measurements. The method employed for measuring distances has proved the most satisfactory yet attempted by these Government expeditions into Alaska. Heretofore the stadia has been employed; also distance measurement by means of a split object glass, by an instrument known as the stenometer. On this trip, however, movable cross hairs in the eye-piece of a telescope were used, the amount of motion of which, or the angle subtended, was measured by a micrometer screw, and by this means it was possible to observe directly distances far in excess of anything possible with the stadia, and much more accurately for the distance. These measurements were made by placing two signal poles at a known distance apart. These were observed from various

points in the route travelled, as long as they remained in sight, and the distance between them was measured by the micrometer screw. The observation on this horizontal base of known length gave the resulting distance. The extreme measurement made in this manner was on a base nearly 700 feet long. The two signals left at each extremity of this were occasionally observed upon up to a distance of thirty miles, which is undoubtedly the greatest distance ever measured directly or by what is known as the range-finder method. Throughout the journey signals were placed on bases varying from 50 to 700 feet in length, according to the distance from which it was expected they might be seen.

In skirting the Great Alaskan Range the party made its nearest camp to Mount McKinley at a distance of only ten miles from the summit in a direct line; thence the surveys were conducted to an altitude of 4,000 feet, within about nine miles of the summit, and Mr. Brooks climbed to an altitude somewhat greater than this. A number of observations were made on the summit to ascertain its elevation, and the reduction of six of these, considered to be particularly good, indicates that it is somewhat lower than the height previously reported three years ago by the first reconnaissance party of the Geological Survey which observed it. The final computations have not yet been made, but they show that the altitude is very close to 20,000 feet—perhaps the highest mountain peak in North America.

The camp at the base of McKinley was on the edge of the snow-line, and from this point the mountain rose in a horizontal distance of but ten miles to a height of 16,000 feet above the camp. This is probably the most abrupt mountain slope for its height in North America. The summit was found to be double-topped, the northern peak being about 1,000 feet lower than the southern or highest peak, and one and three-fourths miles distant.

Another result of this reconnaissance was to distinguish Mount McKinley from the second highest peak of the range — Mount Foraker, which lies about 14½ miles to the south of it, and reaches an altitude of about 17,000 feet. The pass between the two summits is at about an elevation of 10,000 feet, being the highest prominent mountain pass on the continent.

The entire slope of this great mountain mass, for a distance of over fifty miles on the north and west sides, and at all points above the snow-line at 4,000 feet, is under a mass of snow, which has been consolidated into a permanent névé or glacier, so that the whole mountain range may be said to be ice-capped almost as is

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the interior of Greenland. From the snow-line big glacial streams fill the larger valleys. In fifty miles six great glaciers were observed and mapped, and these terminate in streams of water in which the more prominent rivers of the western slope rise.

The territory traversed by this party was of very great extent. The pack train which reached Rampart completed a journey of nearly 800 miles, the longest taken with a pack train in Alaska. In the neighbourhood of the Great Range, especially near Mounts McKinley and Foraker, the country passed through is reported by Messrs. Brooks and Reaborn, both of whom are experienced campaigners in the western United States, as undoubtedly the greatest game country on the continent. The party were never without fresh meat, and they report that on the north slopes of the mountains moose, cariboo, and mountain sheep, or big horns, were unusually plentiful. The cariboo grazed with the pack animals at night, and as many as 100 sheep were counted in a single flock. Ptarmigan, the finest game bird, were so abundant and so tame that all that were needed for food were easily despatched with sticks or shot with pistols. Bear, also, were seen in large numbers, especially grizzly, cinnamon, and black bear. In fact, the country never having been visited by white men, nor in all probability ever hunted by Indians, all varieties of game, in addition to their abundance, were so tame that they could be approached within a few feet.

MR. R. D. CUMMIN, topographer of the U. S. Geological Survey, reports that Blue Mountain in Union Township in the north corner of Bedford County, Pennsylvania, is found to have an elevation of 3,136 feet above mean sea-level. This mountain is about one mile south of the Bedford-Blair County line. Its elevation was determined by careful spirit levels. It is connected with a line of primary levels along the road that skirts the west side of the mountain, and this is based directly on precise levels of the Pennsylvania Railroad; and there seems little doubt as to the accuracy of this height.

THE NORTHWEST CORNER of the Colville Indian Reservation, Washington, in the neighbourhood of Oroville, was surveyed and mapped in detail during the past summer. This region lies immediately east of the Cascade Mountains, along the Okanogan river, and adjacent to the Canadian boundary line. The country is practically an elevated table land, at altitudes of from 3,000 to

7,000 feet. The plateau breaks off sharply, and the streams flow with steep descent into the Okanogan from an escarpment edge having a general altitude of about 2,000 feet to the river valley, which has an elevation of about 900 feet.

The country is interesting because of the number of small lakes, mostly deriving their water supply from the winter snows. They vary in size from ponds of a few acres to lakes covering a square mile; while on the Okanogan, at the Canadian line, is Osogoos Lake, a considerable enlargement of the river, and though nearly nine miles in length, exceedingly shallow, so that a wagon road crosses it on a slight embankment. The upland lakes are, some of them, fresh and others alkaline, and the latter are noteworthy because of the beautiful translucent blue of their water, which is almost an iridescent peacock blue in colour.

A PARTY of the U. S. Geological Survey under Mr. George T. Hawkins spent the summer in extending primary triangulation along the north and south boundary line between the States of Washington and Idaho. A belt of geodetic triangulation covering an area of 5,000 square miles was completed over practically the whole of the celebrated Pelouse river wheat country, one of the most fertile areas in the United States. The country is open and rolling, with few very high hills, and no considerable mountains. It is well inhabited, and traversed by several railways.

ACCESSIONS TO THE LIBRARY.

NOVEMBER–DECEMBER, 1902.

BY PURCHASE.

American Book-Prices Current. Sept. 1901–Sept. 1902. New York, Dodd, Mead & Co., 1902. 8vo.

American Historical Review. Vols. 1–6. New York, The Macmillan Co., 1896–1901. 8vo.

Atlas of 30 Nautical Charts (*circa* 1680–1704) by J. Van Keulen. Amsterdam, Van Keulen *et al.*, 1680 (?). Folio.

Atlas of 52 Nautical Charts. Amsterdam, J. Van Keulen, 1680 (?). Folio.

BARTLETT, W. H., AND BEATTIE, WILLIAM: Ports, Harbours, Watering Places and Coast Scenery of Great Britain. London, George Virtue, 1842. 2 vols. 4to.

BORY DE SAINT VINCENT, J. B. G. M.—Voyage dans les Quatre Principales Iles des Mers d'Afrique: Planches. Paris, F. Buisson, An XIII. (1804). 4to.

BRODHEAD, JOHN ROMEYN.—History of the State of New York. New York, Harper & Brothers, 1853, 1871. 2 vols. 8vo.

Bulletin de Géographie Historique et Descriptive. Paris, E. Leroux, 1886–1900. Tomes 1–15. 8vo.

(BURKE, EDMUND.)—An Account of the European Settlements in America. 6th Edition. London, J. Dodsley, 1777. 2 vols. 8vo.

CAMERON, JOHN.—Our Tropical Possessions in Malayan India. London, Smith, Elder & Co., 1865. 8vo.

CHAMBERLAIN, BASIL HALL.—Things Japanese. 4th Edition. London, John Murray, 1902. 8vo.

Charleston Earthquake, 1886. Charleston, S. C., Alex. M. Cochran (1886). 4to.

Charleston, Souvenir of the Great Earthquake, Aug. 31, 1886. Charleston, Southern Directory & Publishing Co. (1886). Oblong 4to.

CHISHOLM, GEO. G.—Europe: Vol. II., The North West. *Stanford's Compendium of Geography and Travel.* (New Issue.) London, Edward Stanford, 1902. 8vo.

CHITTENDEN, H. M.—American Fur Trade of the Far West. New York, F. P. Harper, 1902. 3 vols. 8vo.

COOPER, WILLIAM.—A Guide in the Wilderness, or the History of the First Settlements in the Western Counties of New York, etc. Rochester, Geo. P. Humphrey, 1897. 8vo. *Reprint from edition of Gilbert & Hodges, Dublin, 1810.*

DAWSON, HENRY B.—Westchester County, New York, during the American Revolution. Morrisania (printed for the Author), 1886. 4to.

Egypt Exploration Fund; *Græco-Roman Branch:* The Tebtunis Papyri. Edited by Bernard P. Grenfell, Arthur S. Hunt and J. Gilbart Smyly. London, Henry Frowde, 1902. 4to.

ELLIS, H. T.—Hong Kong to Manilla and the Lakes of Luzon. London, Smith, Elder & Co., 1859. 8vo.

Encyclopædia Britannica, New Volumes of the. London, Adam and Charles Black, 1902. Vol. V. 4to.

Encyclopædia, Jewish. Vol. III. New York, Funk & Wagnalls, 1902. 8vo.

Encyclopædia, New International. New York, Dodd, Mead & Co., 1902. Vols. 1–4. 8vo.

FISKE, JOHN.—New France and New England. Boston and New York, Houghton, Mifflin & Co., 1902. 8vo.

FRASER, JOHN FOSTER.—The Real Siberia. New York, D. Appleton & Co., 1902. 8vo.

HELMOLT, H. F. (*Editor*).—Weltgeschichte : Band 2, Ostasien und Ozeanien. Der Indische Ozean. Leipzig u. Wien, Bibliographisches Institut, 1902. 8vo.

HOWARD, JAMES Q.—History of the Louisiana Purchase. Chicago, Callaghan & Co., 1902. 8vo.

JOHNSTON, SIR HARRY.—The Uganda Protectorate. London, Hutchinson & Co., 1902. 2 vols. 8vo.

KWONG KI CHIU.—Dictionary of English Phrases. New York, A. S. Barnes & Co., 1881. 8vo.

MALLET, P. H.—Northern Antiquities : or, a Description of the Manners, etc., of the Ancient Danes, etc., etc. With Additional Notes by the English Translator. London, T. Carnan & Co., 1770. 2 vols. 8vo.

MAP. Afrique Occidentale. 1/500,000. Paris, H. Barrère, 1902. 4 sheets.

MAP. France : Carte des Rivières Navigables et des Canaux. 1/390,000. Paris, H. Barrère, 1902. *Sheets.*

MAP. United States, the British Provinces, Mexico and Part of the West Indies, Case's Map of. Hartford, Conn., O. D. Case & Co., 1874. *4 sheets, mounted.*

MARVIN, W. L.—The American Merchant Marine, 1620–1902. New York, Charles Scribner's Sons, 1902. 8vo.

Massachusetts Historical Society : Proceedings, 1791–1902. Boston, Mass. Hist. Soc., 1859 (reprint) –1902. 36 vols. 8vo. Collections, 1792–1899. (6 series of 10 vols. each.) Boston and Cambridge, Mass. Hist. Soc., 1810 (reprint) –1899. 60 vols. 8vo.

MELVILLE, HERMAN.—Moby-Dick ; or, The Whale. New York, Harper & Brothers, 1851. 12mo.

MOORE, A. W.—The Alps in 1864. Edited by Alex. B. W. Kennedy. Edinburgh, David Douglas, 1902. 8vo.

MURRAY, GEORGE (*Editor*).—The Antarctic Manual for the Use of the Expedition of 1901. London, Royal Geographical Society, 1901. 8vo.

New York City, Manual of the Corporation, 1844–5. D. T. Valentine. New York, J. F. Trow & Co., 1844. 16mo.

New York Mirror. Vol. 15. New York, 1837. 4to.

PICKETT, A. J.—History of Alabama and Incidentally of Georgia and Mississippi. Charleston, Walker & James, 1851. 2 vols. 12mo.

Randall, Robt. Richard. Copy of the Will and Testament of the late. New York, Robert Carter, 1842. 8vo.

RICHARDSON, GEO. G.—The Corn and Cattle Producing Districts of France. London, Cassell, Petter & Galpin (1878). 8vo.

RUTTY, JOHN.—An Essay towards a Natural History of the County of Dublin. Dublin, printed for the Author, 1772. 2 vols. 8vo.

STUEBE, R. (*Editor*).—El Libro de Marco Polo. Leipzig, Dr. Seele & Co., 1902. 8vo.

TALBOT, WILLIAM (*Translator*).—Discoveries of John Lederer, etc., Virginia to the West of Carolina, etc. Rochester, Geo. P. Humphrey, 1902. 8vo. *Reprinted from edition of Samuel Heyrick, London, 1672.*

TENNANT, ROBERT.—Sardinia and its Resources. Roma, Libreria Spithöver, 1885. 8vo.

TIESSEN, ERNST.—China; das Reich der achtzehn Provinzen. Erster Teil: Die allgemeine Geographie des Landes. Berlin, Alfred Schall, 1902. 8vo.

TUCKERMAN, BAYARD.—Peter Stuyvesant. New York, Dodd, Mead & Co., 1893. 16mo.

Verhandlungen des deutschen Geographentages: 10–13. Berlin, D. Reimer, 1893–1901. 4 vols. 8vo.

Who's Who, 1903. London, Adam & Charles Black, 1903. 8vo.

WILLIS, N. PARKER.—Summer Cruise in the Mediterranean. New York, Charles Scribner, 1853. 12mo.

YOUNG, ALEXANDER.—Chronicles of the First Planters of the Colony of Massachusetts Bay, 1623–1636. Boston, C. C. Little & J. Brown, 1846. 8vo.

BY GIFT.

From William S. Bennet, Assemblyman, New York:

Sixth Annual Report Forest, Fish and Game Commission. Albany, James B. Lyon, State Printer, 1901. 4to.

From the Bibliotheca Nacional, Rio de Janeiro:

Apontamentos para o Diccionario Geographico do Brazil, Alfredo Moreira Pinto, Rio de Janeiro, 1887–1889, 5 vols., 8vo.; Catalogo da Exposição Permanente dos Cimelios da Bibliotheca Nacional. Rio de Janeiro, Bibl. Nac., 1885. 8vo.

From Albert Perry Brigham, Hamilton, N. Y.:

Colgate University, Department of Geology and Natural History: Circular of Information No. 8, 1901–1902. pr., 8vo.

From J. H. Brownlee, Atlin, B. C.:

Map of Atlin Mining District, compiled from the latest Surveys by Brownlee & Lowry, Civil Engineers. Scale 4 miles=1 inch. Atlin, B. C., 1902. *Sheet*, 27 x 21¾ in. (blue print).

From the Commission Française des Glaciers:

Rapport sur les Variations des Glaciers Français de 1900 à 1901, présenté à la Commission par M. W. Kilian: Revue de Glaciologie, par M. Ch. Rabot. *Extrait de l'Annuaire du Club Alpin Français, 28e volume–1901.* Macon, Protat Frères, 1902, 8vo.

From W. M. Davis, Author, Cambridge, Mass.:

River Terraces in New England. *Bulletin of the Museum of Comparative Zoölogy at Harvard College, Vol. XXXVIII: Geological Series, Vol. V, No. 7.* Cambridge, Mass., Oct., 1902. 8vo.

From the Editor of "Notes and Queries," London:

The Lost Manuscript of the Reverend Lewis Rou's "Critical Remarks upon the Letter to the Craftsman on the Game of Chess," written in 1734 and dedicated to His Excellency William Cosby, Governor of New York. Florence, the Landi Press, MCMII., p. 8vo.

From Prof. William Libbey, Princeton, N. J.:

Parliamentary Papers, German Government: No. 436. Entwickelung des Kiautschou-Gebiets, Berlin, 1902; No. 437. Anlagen: Schutzgebiete in Afrika, und in der Südsee, nebst Denkschrift über Afrikafonds. (Berlin), 1900–1902. (Three unbound 4tos.)

From Benjamin Smith Lyman, Author, Philadelphia, Pa.:

The Original Southern Limit of the Pennsylvania Anthracite-Beds [*from the Transactions of The American Institute of Mining Engineers, 1902*]; Accounting for the Depth of the Wyoming Buried Valley [*from the Proceedings of The Academy of Natural Sciences of Philadelphia, June, 1902*]; On the Adoption of the Metric System.—Discussion. *Reprinted from the Journal of the Franklin Institute, July, 1902.*

From Albert Matthews, Author, Boston, Mass.:

The Purgatory River of Colorado. *Reprinted from the Publications of the Colonial Society of Massachusetts, Vol. VI.* Cambridge, 1902, p. 8vo.

From the Department of the Interior, Ottawa, Canada:

Report on an Exploratory Survey between Great Slave Lake and Hudson Bay, Districts of Mackenzie and Keewatin. By J. W. Tyrrell, D. L. S. *Appendix No. 26, Part III, Annual Report, 1901.* Ottawa, 1902, 8vo. With case of accompanying maps, 22 sheets.

From the Geological Survey Department of Canada, Ottawa:

Geological Map of the Dominion of Canada (Western Sheet). Scale, 50 miles to 1 inch. Edition of 1901. *Sheet,* 34½ x 29½. (Ottawa, 1902.)

From the Royal Geographical Society, London:

Year-Book and Record, 1902. London, Royal Geographical Society, 1902. 8vo.

From Edward Wellman Serrell, Author, New York:

The Darien Mandingo Canal. New York, 1902, p., 8vo.

From the Secretary of War, Washington, D. C.:

Report on certain Economic Questions in the English and Dutch Colonies in the Orient. By Jeremiah W. Jenks, Special Commissioner. Washington, 1902, pr., 8vo; Pronouncing Gazetteer and Geographical Dictionary of the Philippine Islands. Washington, Government Printing Office, 1902. 8vo.

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BOOK NOTICES.

Through Hidden Shensi. By Francis H. Nichols. Illustrated from photographs taken by and for the Author. Charles Scribner's Sons, New York, 1902.

Mr. Nichols says in his Preface:

> I had all the prejudices of the foreigner when I first crossed the gray plain and met the old race . . . . ; but as I went in and out among them they began to interest me. I found that they had achieved much, but were free from boasting; that they loved their own kind of learning; . . . . that they strove to do right as they saw the right . . . . This narrative offers no solutions of Chinese problems, points no morals, and draws no conclusions.

The book is an attempt at a picture of Oldest China and its people as they appeared to a fair-minded, keen-sighted observer, who has the gift of making his readers agree with him.

Shensi is a province of northwestern China, with an area of about 80,000 square miles, and a population of not far from nine millions, of a race held to be among the finest in the empire.

It was the seat of the Mohammedan revolt of 1868–1873, and Mr. Nichols was told in Peking that his life would not be safe among a people so hostile to foreigners.

He travelled with passports from Prince Ching, and met with no difficulty, though his visit was during the time of the Boxer trouble. Throughout his journey, from Peking to the west and in the province of Shensi, he found the people kindly and courteous, as became the heirs of an ancient civilization. This urbanity and the deeply-sunken roads are the visible signs of antiquity in a land almost destitute of monuments, as compared with other countries.

Like all those who have become acquainted with the Chinese at home, Mr. Nichols was charmed with their family life. He says:

> Ride into any Shensi village about sunset on a summer evening and you will see a father and mother in front of their mud house, with their four or five little boys and girls about them, playing, romping, and all laughing and happy together.

These children were strong and healthy, with ruddy complexions and bright eyes, and with a natural, trusting manner towards strangers. There comes a change for the girls, however, at the age of eight, when the foot-binding begins, universal in Shensi.

On his way through Shansi (the province east of Shensi) Mr. Nichols saw on every side the ruin and degradation caused by the opium habit, and he declares that he has never met with a

Chinaman who did not regard it as a curse to the nation. The highest form of recommendation bestowed upon a man in the interior of China was invariably: *He has never smoked opium.*

The account of Sian (Si-ngan-fu) and the Sianese has a peculiar interest. This capital of Shensi is one of the oldest cities on earth and very much the same to-day as it was in the beginning. Its streets are wide, and intersect each other at right angles, and the principal ones are paved with stone blocks. Sian is famous for its banks, which have correspondents all over the empire; yet the city has no post-office. Letters are sent by messengers.

Mr. Nichols made his visit just after Shensi was recovering from one of the worst famines of the century; but there was no street that corresponded in any way to what we should term a *poor quarter*, no gambling-house or public gaming, no liquor saloon, no *dive*. Mr. Nichols affirms that places of this character are only to be found in China in foreign concessions, in treaty ports; and he quotes the remark of a Mohammedan tea-merchant that he

> should rather like to see the Christians overthrow the idols and convert China to the worship of the One God, but the only trouble is if Sian were a Christian city it would be as bad as Shanghai.

Mohammedans of whatever race have a way of making the Nazarene uncomfortable by odious comparisons.

The famous Nestorian Tablet is still to be seen in a neglected field about a mile beyond the western gate of Sian, in the midst of ruins near a small Taoist temple. Three tablets are mounted side by side on stone tortoises, the Nestorian, distinguished by a small Greek cross near the top, standing between the other two. Mr. Nichols obtained a rubbing of the inscription and an impression of a small inscription on the side of the tablet, previously overlooked. This shorter inscription is translated as follows by Dr. Martin:

> In the reign of Hien Fung, 1079 years after the erection of this monument, it was visited by Han Tai Hua, of Wulin, who caused the pavilion to be rebuilt. I grieve that my deceased friend, Governor Woo, could not be with me on this occasion.

The pathos of the original seems to have escaped in the translation.

From the ancient city Mr. Nichols and his friend Mr. Duncan started for a week's journey through the Tsin-ling mountains to Lung-chü-chai, where they were to embark on the Han-Kiang river for Hankow, on their way to Shanghai. The Tsin-ling mountains are the watershed between the Hwang-ho on the north and the Yang-tse-Kiang on the south. They are treeless and lonely, the only birds being occasional flocks of crows. There are wolves, said to enter villages and attack caravans, and a few *jaguars*, though it does not appear how these made their way into China.

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The boats on the Han-kiang are remarkably like American canoes, pointed at both ends, and with a sheer slope towards the centre of the bottom (there is no keel), which is about four inches in width. All the boats have water-tight compartments. The river is rarely deep enough to admit of steering, but a long pole with a board on the end serves for a rudder on occasion. The boatmen are very like American Indians, and all the traffic of Shensi with the Yang-tse-kiang is carried in their light canoes. With his arrival at Hankow Mr. Nichols closes his most entertaining and instructive volume.

The illustrations, mostly taken by the author, are many and excellent.

A Pronouncing Gazetteer and Geographical Dictionary of the Philippine Islands, United States of America, with Maps, Charts, and Illustrations. Also the Law of Civil Government in the Philippine Islands, passed by Congress and approved by the President July 1, 1902, with a Complete Index. Prepared in the Bureau of Insular Affairs, War Department, 1902. (September 30, 1902.) *Washington, Government Printing Office, 1902.*

This Gazetteer is a compendium of information, gathered from all available sources, concerning the Philippine Islands, their geography, physical features, commerce, resources, population, etc., followed by an alphabetically-arranged list of islands, provinces, towns, lakes, mountains, light-houses, etc., etc., to the number of 10,300, with maps, charts, and illustrations.

The volume contains 933 closely and handsomely printed pages, admirably arranged and condensed, and it does the greatest credit to the resources of the War Department.

Without taking part in the discussion of a reform in the spelling of Filipino names, the Gazetteer wisely retains the old Spanish orthography, not only because Government publications follow that system, but with the view of avoiding further confusion on the subject.

The test of a geographical dictionary is its use, and that is an affair of time, which may be trusted to establish the authority of this book.

NOTES AND NEWS.

THE ANNUAL MEETING of the Society will be held at Mendelssohn Hall, No. 119 West Fortieth Street, on Tuesday, the 27th of January, 1903, at 8.30 o'clock P.M.

After the presentation of reports, the election of Fellows, and other business, Prof. William Libbey will address the Society on his recent visit to the Jordan Valley and Petra.

On the 17th of February, Prof. E. L. Stevenson, of Rutgers College, will read a paper on Martin Waldseemüller and the Earliest Cartography of the New World.

THE AMERICAN ALPINE CLUB has for its objects the Scientific Exploration and Study of the Higher Mountain Elevations and of the regions lying within or about the Arctic and Antarctic Circles, the cultivation of the Mountain Craft, and the Promotion and Dissemination of Knowledge regarding the regions above indicated.

Those are eligible for membership who have made the ascent of one or more mountain elevations "acceptable" to the Board of Directors; no mountain to be allowed which does not rise 2,000 feet above the snow-line of its region;

Those who have conducted exploration in the Arctic or Antarctic tracts, or contributed substantially to a knowledge of the natural phenomena of those regions and of the regions of high mountain elevations;

And those who are engaged in the special study of (recent) glacial phenomena.

The constituted home of the Club is Philadelphia.

The President is Charles E. Fay and the Secretary Henry G. Bryant, 2013 Walnut Street, Philadelphia.

THE PORTRAITS in the *Almanach de Gotha* for 1903 are those of Alexandra, Queen of Great Britain and Ireland, Edward VII, Theodore Roosevelt, President of the United States, and Chrétien Ernest, Prince of Stolberg.

The editors record the disappearance of the South African Republic and the Orange Free State and the entrance of Cuba to her place among the nations.

A reference to the statistics of Greece shows that the areas of the 26 Provinces, created by the law of July 6, 1899, are still undetermined.

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MINERVA, for 1902–3, registers on page 1147 the foundation of the British Academy and the names of the first 49 members. The frontispiece of this twelfth volume is a portrait of Léopold Delisle, the head of the Bibliothèque Nationale, Paris.

U. S. BOARD on Geographic Names—Decisions, Dec. 3, 1902.

ARABELLA: island (Canadian), in the St. Lawrence river, near Clayton, Jefferson County, N. Y. (Not Ambella nor Amelia.)

BEHESTIAN: township, Ouachita County, Arkansas. (Not Behrstian.)

BRAKEL: creek, Chenango and Cortland Counties, N. Y. (Not Brackel nor Braket.)

CANADARAGO: lake, Otsego County, N. Y. (Not Schuyler.)

CAPE ROSIER: P. O., Hancock County, Me. (Not Cape Rozier.)

CATATONK: creek, P. O. and R.R. station, Tioga County, N. Y. (Not Catatunk.)

CHANNAHATCHEE: creek, Elmore County, Alabama. (Not Cedar.)

DIDDELL: P. O. and R.R. station, Dutchess County, N. Y. (Not Didell.)

FREEO: bayou Douglas and Ouachita Counties, and township, Ouachita County, Ark. (Not Frio.)

GRENELL: island, in St. Lawrence river, and P. O., Jefferson County, N. Y. (Not Grennell, Grinnell, nor Stuart.)

HEART: island, in St. Lawrence river, Jefferson County, N. Y. (Not Hart nor Hemlock.)

IONIA: P. O., R.R. station and village, Ontario County, N. Y. (Not Millers Corners.)

LAKE OF THE ISLES: lake on Wellesley island, St. Lawrence river, Jefferson County, N. Y. (Not Waterloo.)

LEEK: island (Canadian), St. Lawrence river, near Grindstone island, Jefferson County, N. Y. (Not Leak nor Leake.)

LITTLE TOBEHANNA: creek, Schuyler County, N. Y. (Not Little Tobyhanna.)

LOUNSBERRY: locality, P. O. and R.R. station, Tioga County, N. Y. (Not Canfields Corners.)

MCGRAW: P. O., R.R., station and village, Cortland County, N. Y. (Not McGrawville.)

MILLEN: bay, St. Lawrence river, Jefferson County, N. Y. (Not Mellen nor Millens.)

MUD: lake, Jefferson County, N. Y. (Not Edmund nor Edmonds.)

NOWADAGA: creek, Herkimer County, N. Y. (Not Indian Castle nor Nouadaga.)

OCQUIONIS: creek, Otsego and Herkimer Counties, N. Y. (Not Fish.)

OSBURN: P. O. and R.R. station, Shoshone County, Idaho. (Not Osborne.)

PETRI: P. O. and R.R. station, Hancock County, Ky. (Not Petrie nor Petri Station.)

PHILOMEL: creek, Jefferson County, N. Y. (Not Phileman nor Philemon.)

SALUBRIOUS: point, Lake Ontario, Jefferson County, N. Y. (Not Vesuvius.)

SAVILTON: locality and P. O., Orange County, N. Y. (Not Savill, Savil nor Saville.)

SHADOW; brook, Otsego County, N. Y. (Not East Springfield.)

STANBRO: village, Chenango County, N. Y. (Not Stambro.)

STERLING: township, Vernon County, Wis. (Not Stirling.)

SOCAPATOY: creek, precinct and village, Coosa County, Alabama. (Not Socapartoy, Soccopotoy nor Sucapatova.)

TERLINGUÀ: creek, P. O. and village, Brewster County, Texas. (Not Latis Langua, Tarlinga, Tasa Lingo, Terlinga, nor Terlingo.)

TOBEHANNA: creek, Schuyler County, N. Y. (Not Tobyhanna nor Big Tobyhanna.)

TRAVELERS REST: P. O. and precinct, Coosa County, Ala. (Not Travellers Rest.)

TYGART: river, W. Va. (Not Tygarts Valley nor Valley.)

VANDUSER: P. O. and R.R. station, Ouachita County, Ark. (Not Vanduser nor Van Duzer.)

VOLCAN: mountains, San Diego County, Cal. (Not Balcan nor Bolcan.)

WOLFE: island (Canadian), St. Lawrence river, near Clayton, Jefferson County, N. Y. (Not Grand nor Long.)

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TRANSACTIONS OF THE SOCIETY.

NOVEMBER–DECEMBER, 1902.

A Regular Meeting of the Society was held at Mendelssohn Hall, No. 119 West Fortieth Street, on Tuesday, November 18, 1902, at 8.30 o'clock P.M.

Vice-President Moore in the chair.

The following persons, recommended by the Council, were elected Fellows:

Charles R. Henderson.	Alfred Bates.
Pliny Fisk.	Hon. Henry Clay White.
Harvey Edward Fisk.	Charles P. Bowditch.
Francis H. Burrage.	Albert C. Burrage, Jr.
Henry Clay Pierce.	Russell Burrage.
Zenas Crane.	Robert S. Brewster.
Edward F. Eberstadt.	Edward N. Vose.
Wm. F. Havemeyer.	David Paton.
Charles W. Baker.	J. Knowles Hare.
Louis K. Cotton.	S. Duncan Leverich.

Mrs. Edward King.

The Chairman then introduced Civil Engineer R. E. Peary, U. S. N., who addressed the Society on the Work of the Peary Arctic Club in the Arctic in 1898–1902. Stereopticon views were shown.

On motion, the Society adjourned.

A Regular Meeting of the Society was held at Mendelssohn Hall, No. 119 West Fortieth Street, on Tuesday, December 23, 1902, at 8.30 o'clock P.M.

Vice-President Mills in the chair.

The following persons, recommended by the Council, were elected Fellows:

Henry Lloyd Smyth.	Francis H. Nichols.
Frederick W. Seward.	John Monks, Jr.
G. J. McCormac.	Edward G. Wyckoff.
Samuel D. Warren.	F. F. Taylor.

The Chairman made the following announcement:

The Society is already informed that our late President Daly bequeathed the sum of Five Thousand Dollars to found a gold medal, to be awarded, from time to time, for distinction in geographical discovery and science.

It has been decided that this medal shall be known as the Charles P. Daly Medal, and it is now my pleasing duty to announce that the Council, on the 11th of December, by unanimous vote, made the first award to Robert E. Peary for his explorations in the Arctic in the years 1898–1902.

The Chairman then introduced the speaker of the evening, Mr. George S. Morison, who addressed the Society on the Panama Canal.

On motion, the Society adjourned.

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